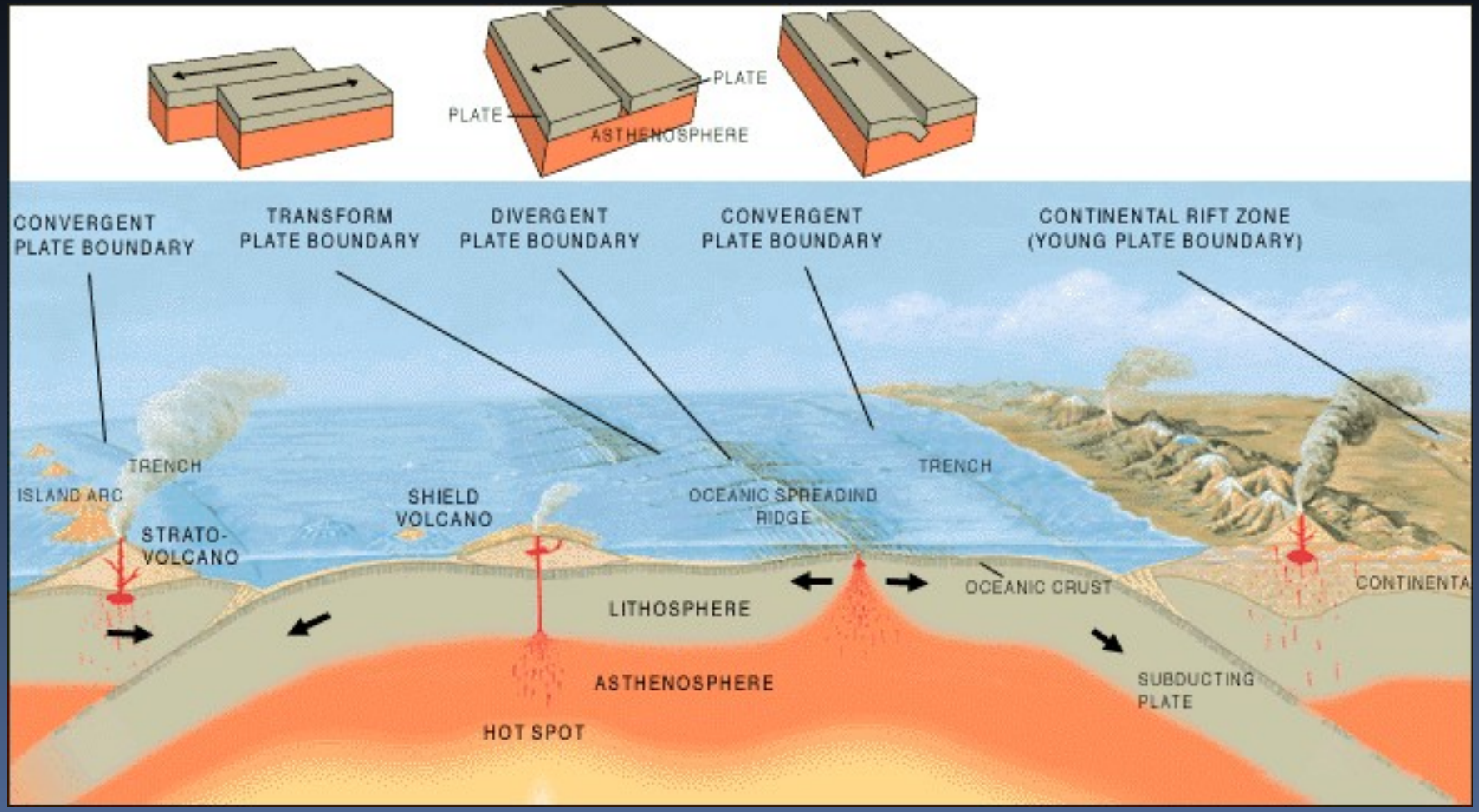
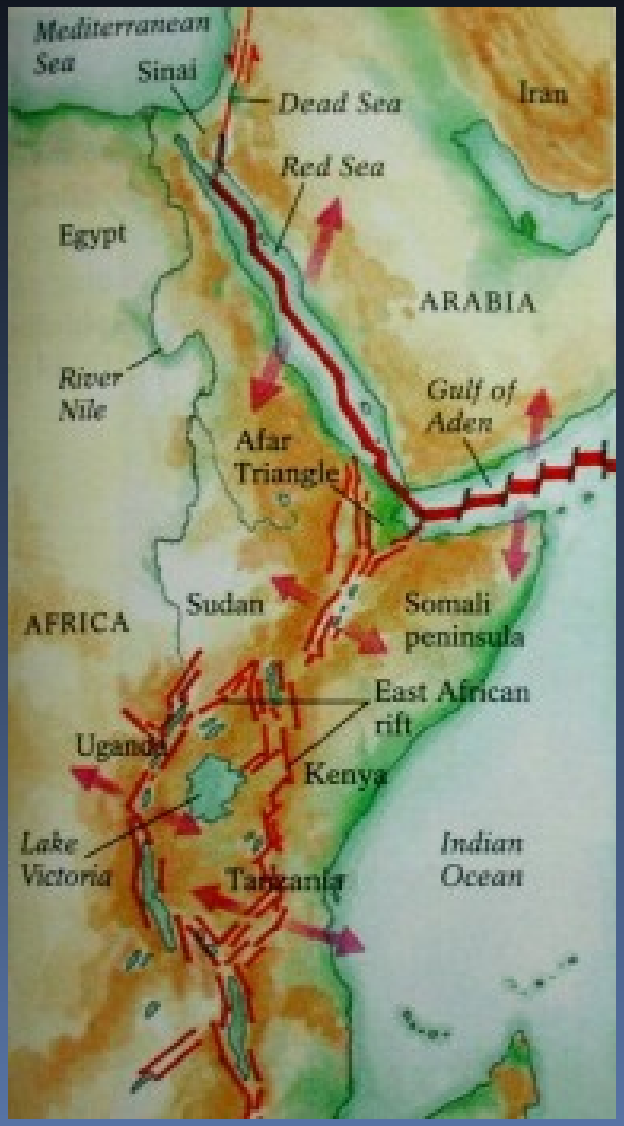
ESTRUTURAS RÚPTEIS DISTENSIVAS

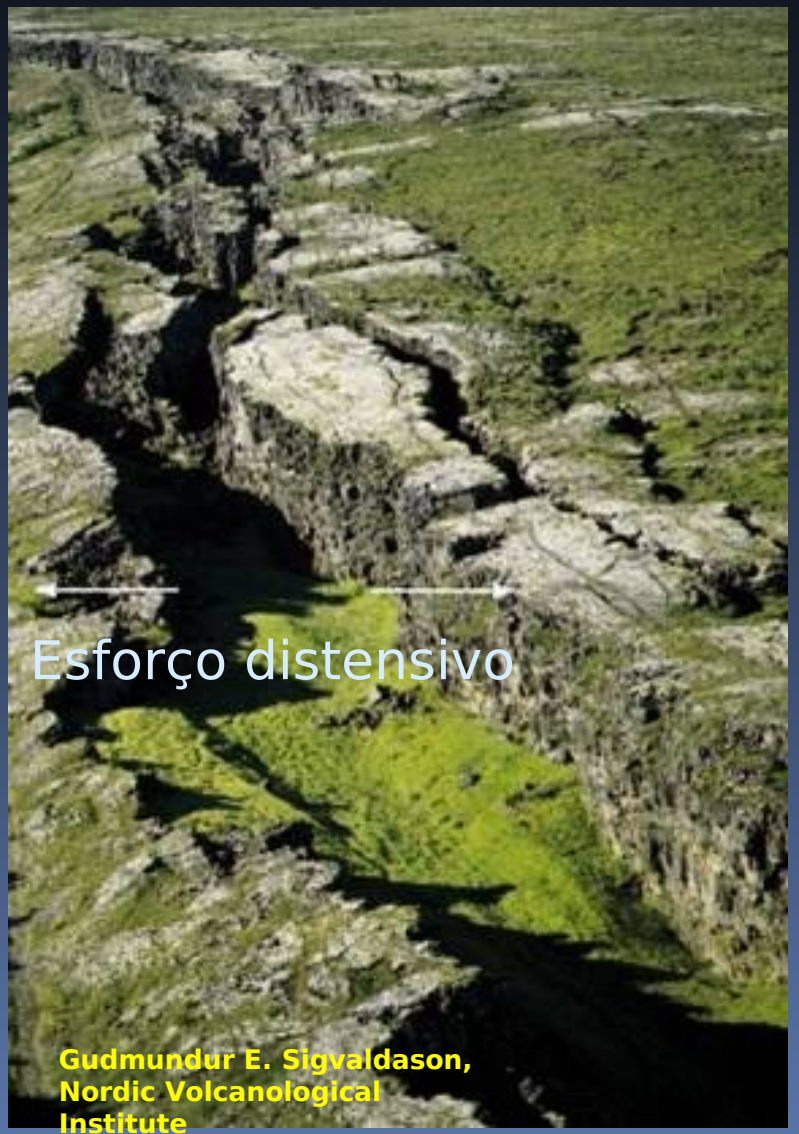


Limites de placas – convergente, divergente e transformante.

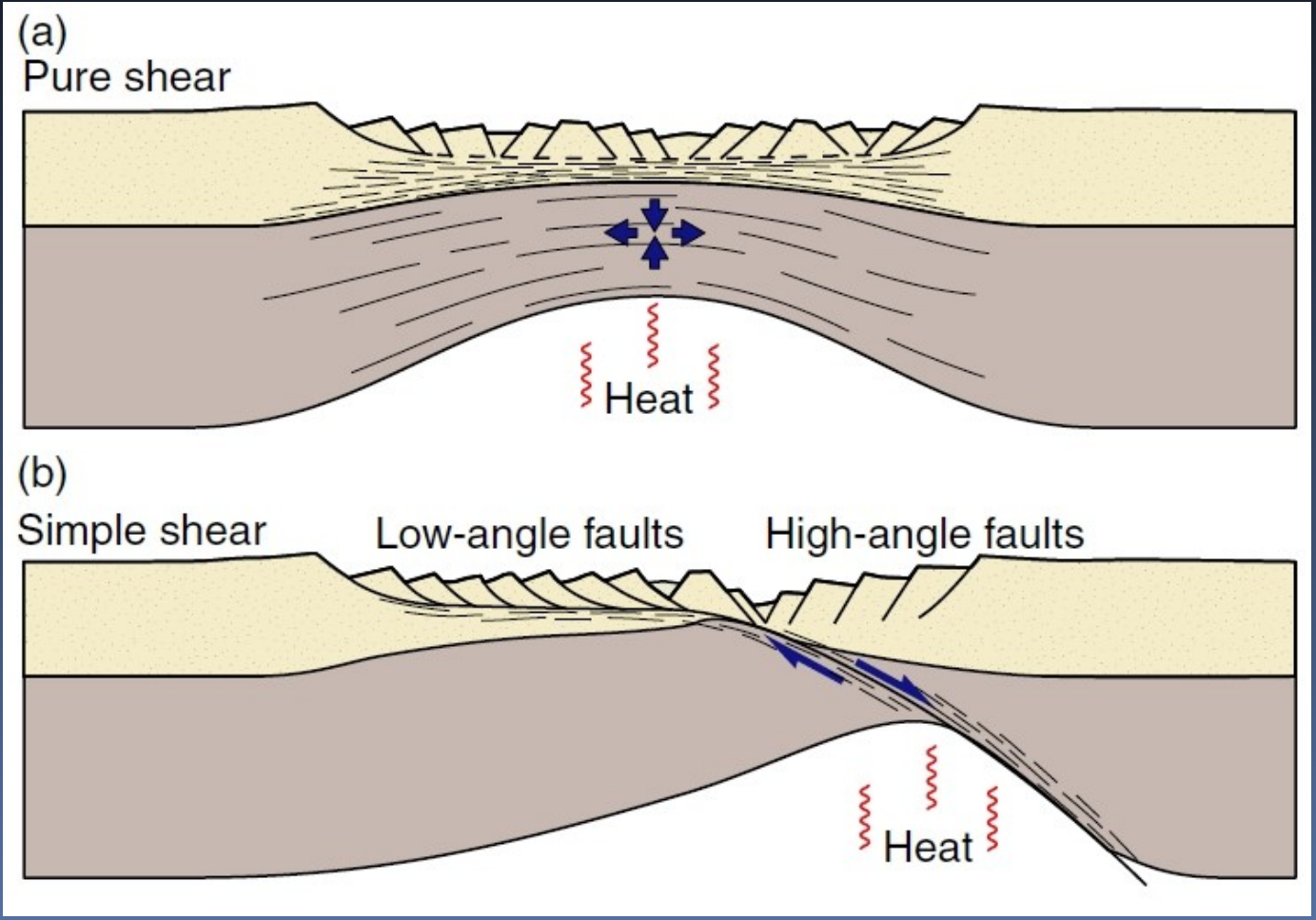
ESTRUTURAS RÚPTEIS DISTENSIVAS

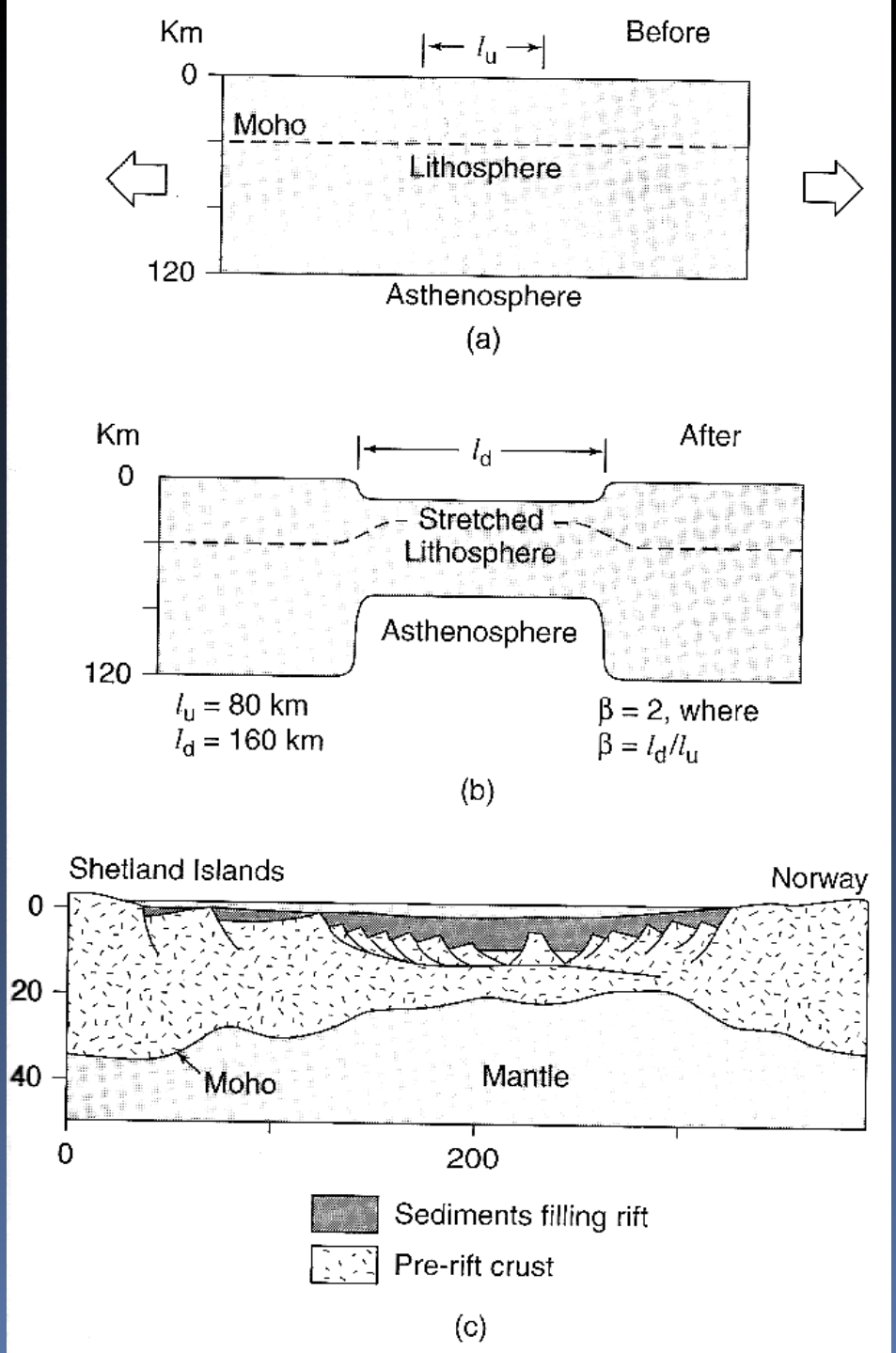
Formadas por distensão ortogonal ou oblíqua





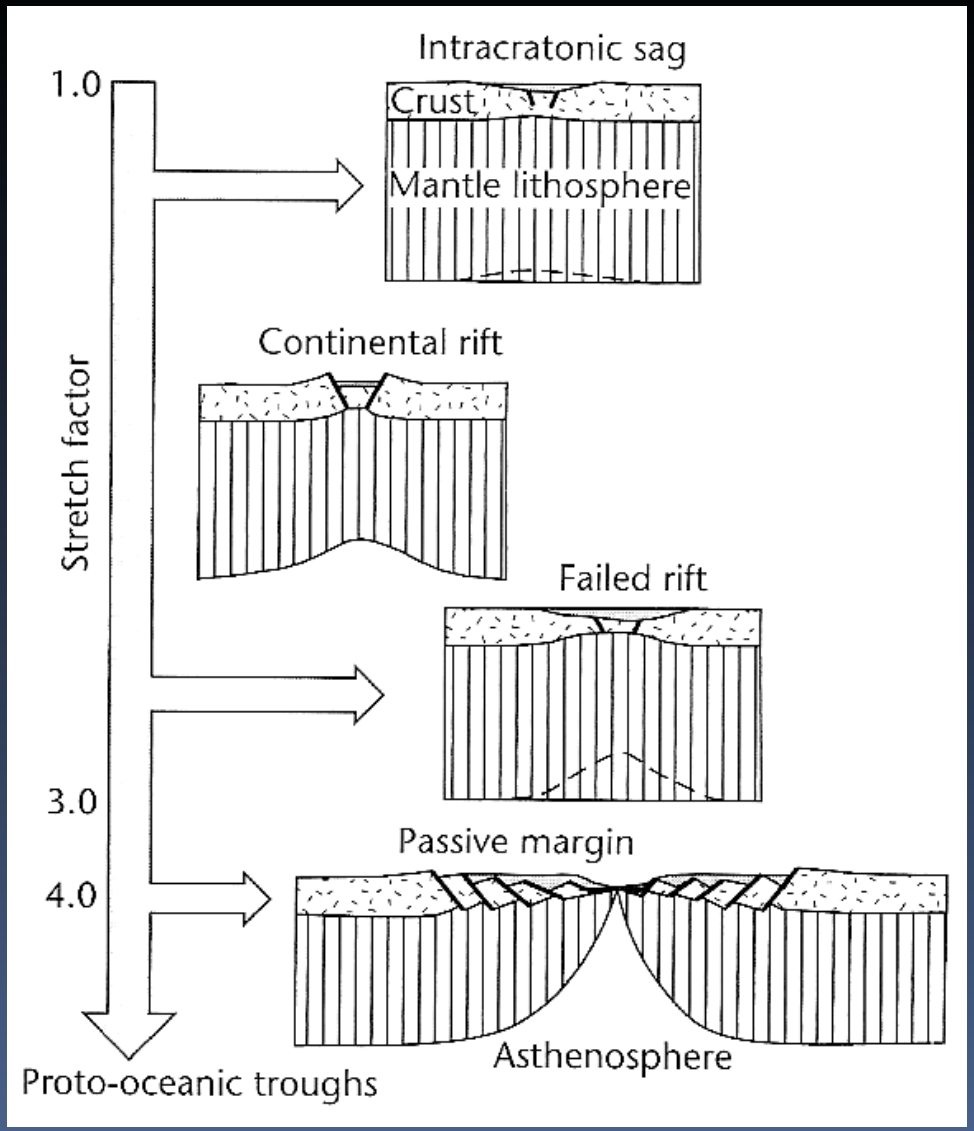
Formação de riftes por cisalhamento puro (modelo de Mackenzie, 1978) e por cisalhamento simples (modelo de Wernicke, 1985).





β - fator de estiramento

β = L final/ Linicial



Bacia intracratônica

Rifte continental

Rifte abortado

Margem passiva

Classificação de bacias rifte de acordo com o seu fator de estiramento - β

FRATURAS

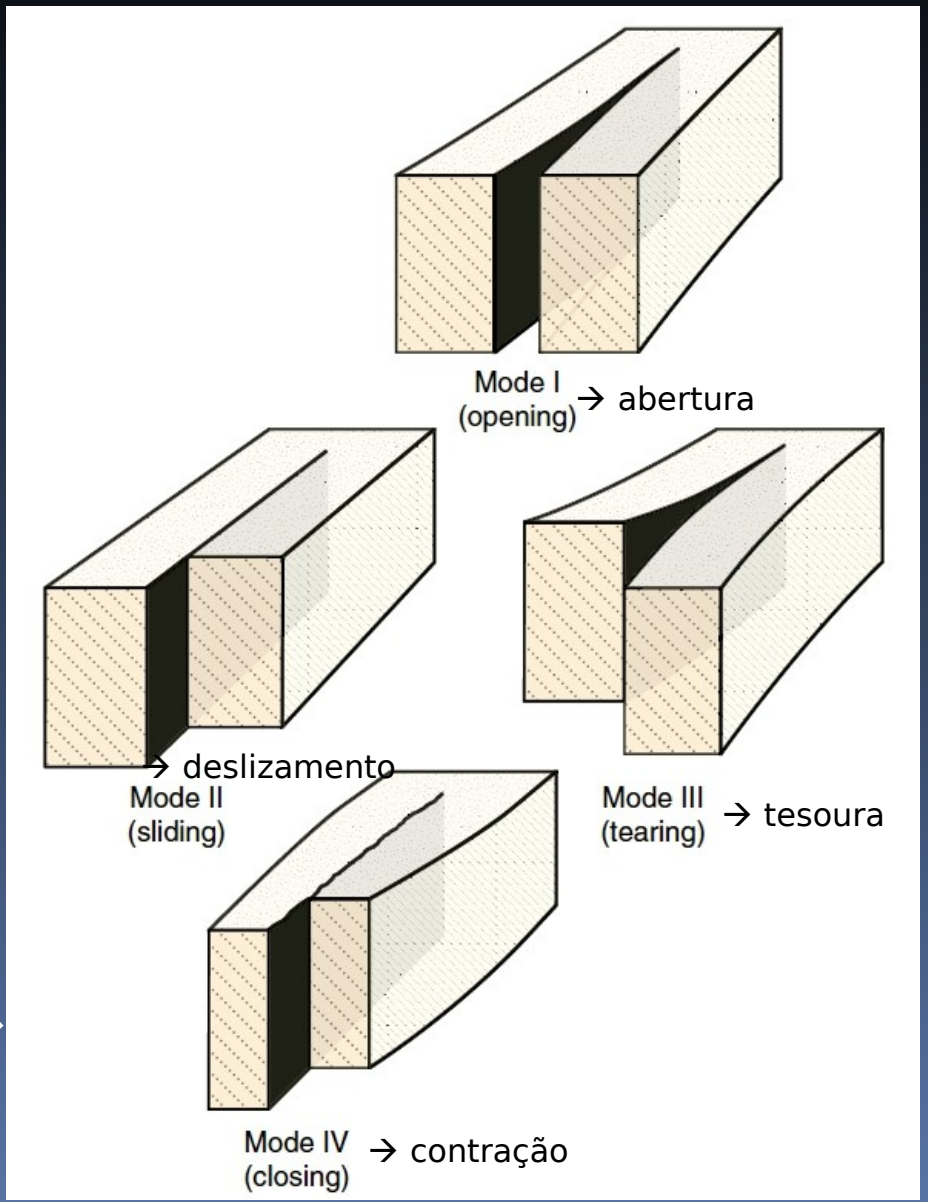
- Fraturas → abrangem juntas e falhas
  - Juntas → distensão com movimento ortogonal ao plano de fratura
  - Fraturas híbridas → movimento ortogonal (distensivo) e paralelo ao plano (cisalhamento)
  - Fraturas de cisalhamento = Falhas → movimento paralelo ao plano (cisalhamento)

Modos de Fraturamento

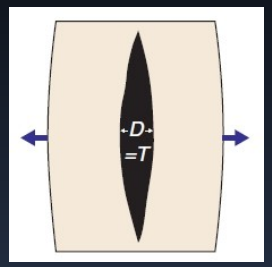
Juntas→

Falhas →

Estilolitos→

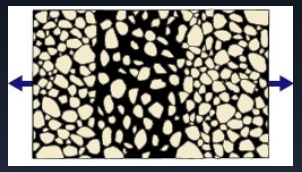


rocha não porosa

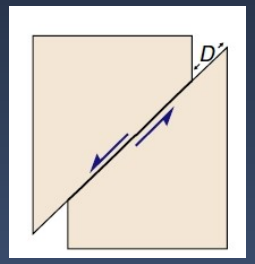


junta

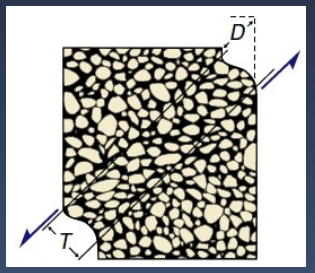
rocha porosa



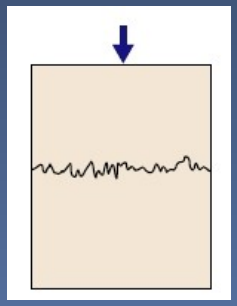
banda de dilatação



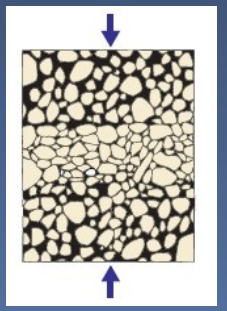
fratura de cisalhamento



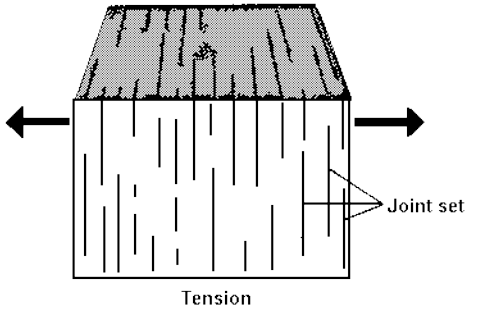
banda de cisalhamento

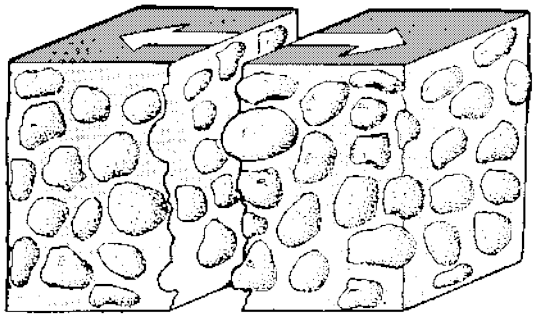


estilolito

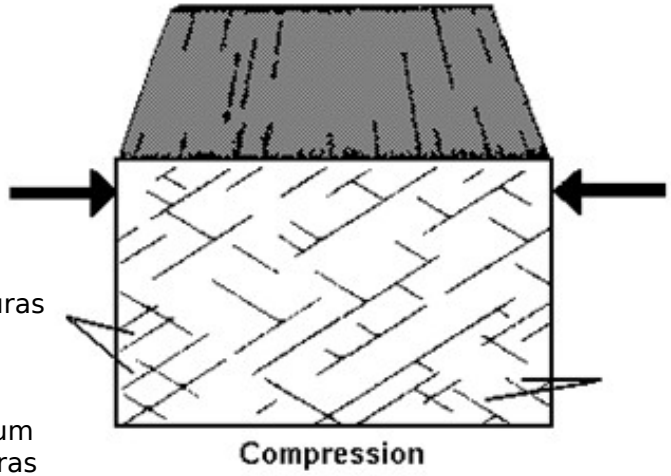


banda de compactação

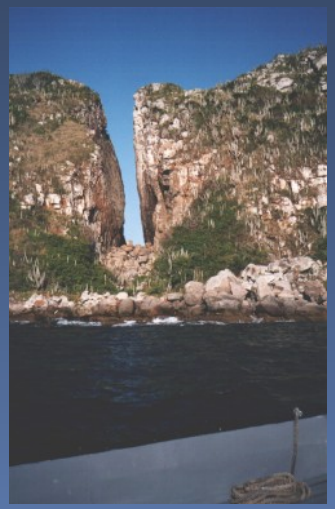




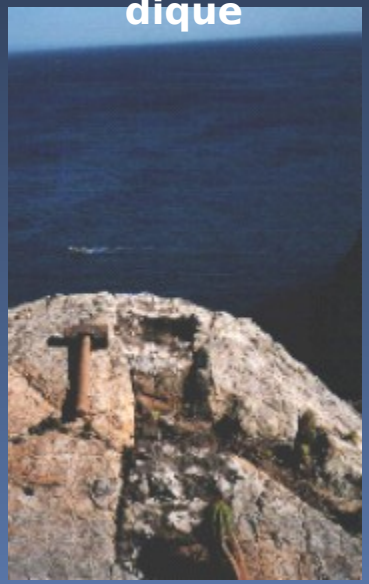
Famílias de fraturas de cisalhamento conjugadas
Um conjunto de famílias formam um **sistema** de fraturas



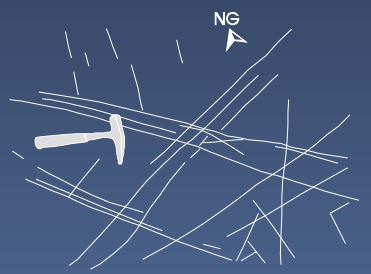
Juntas, veios e diques

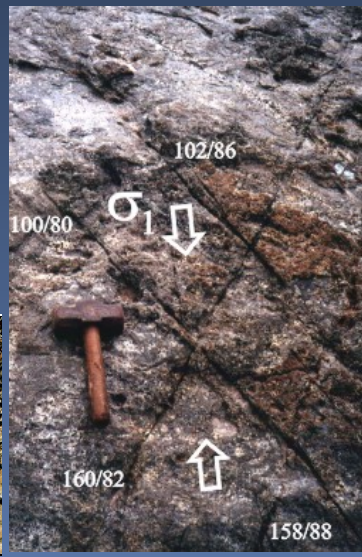


Fratura híbrida preenchida por dique



Fraturas de cisalhamento conjugadas - falhas

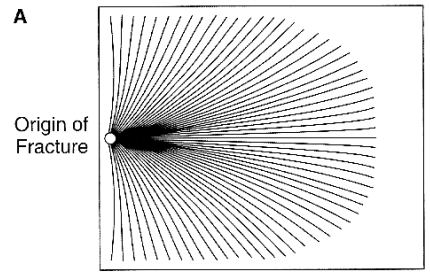


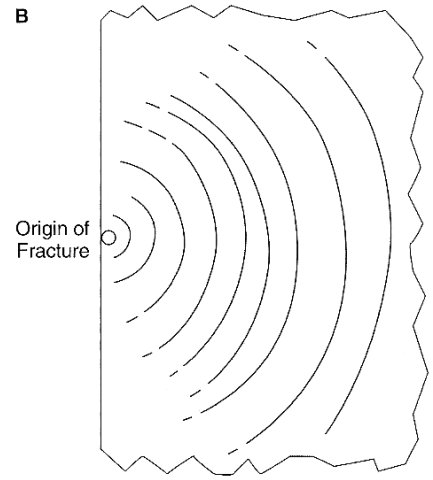


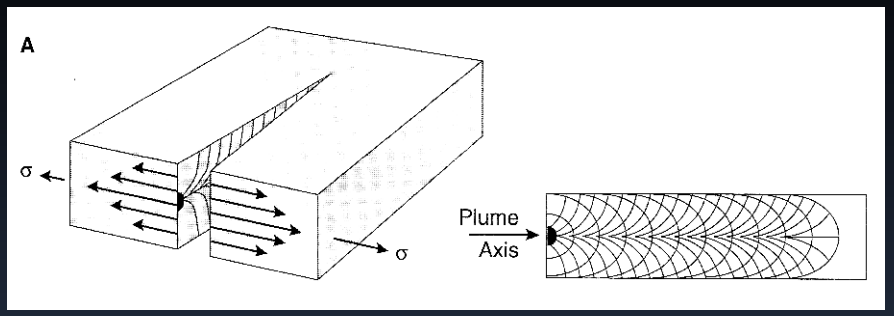
Feições de crescimento na superfície de juntas

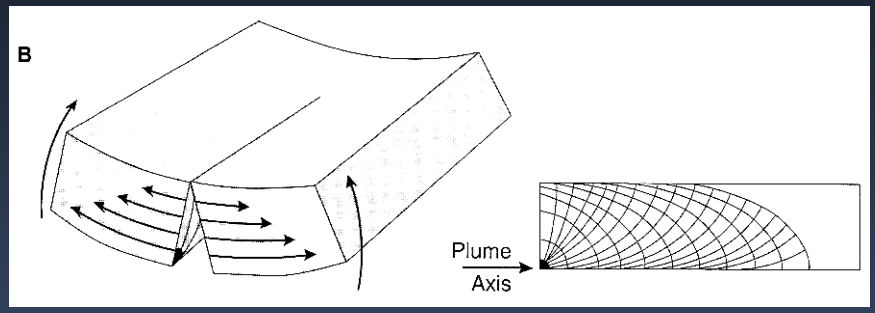
entalhes - hackles

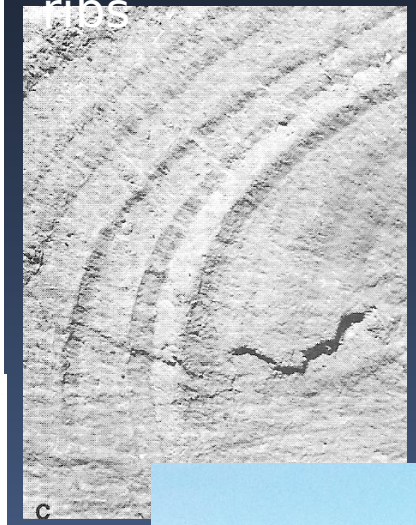
costelas – ribs

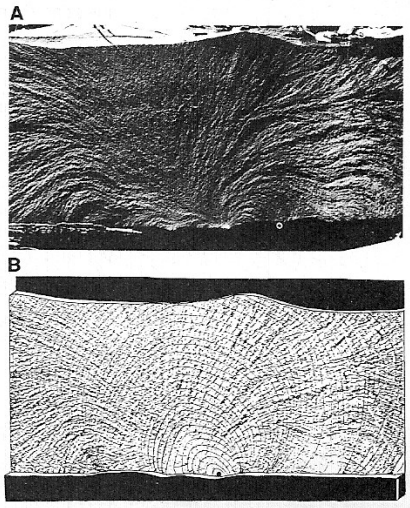




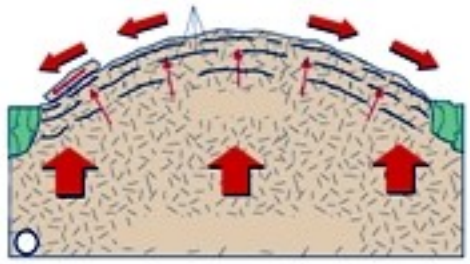




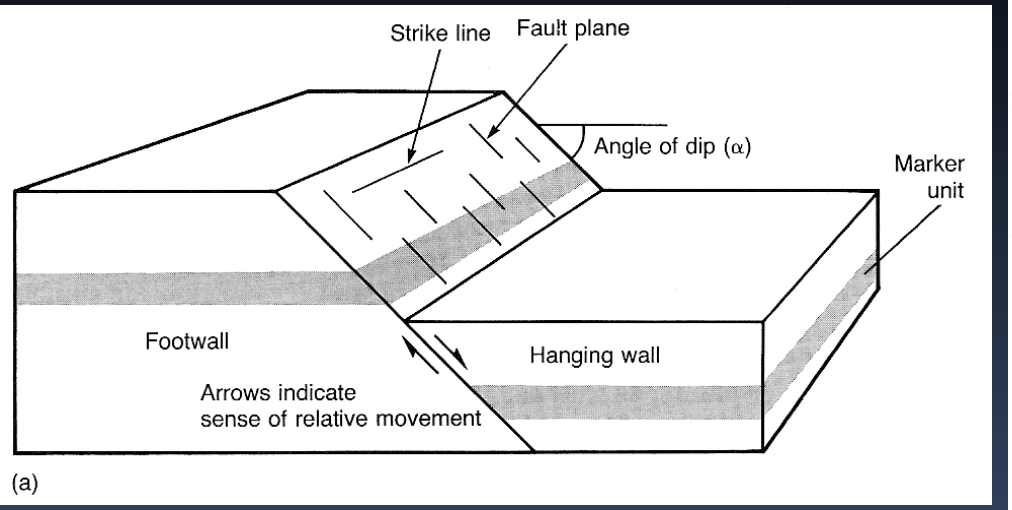


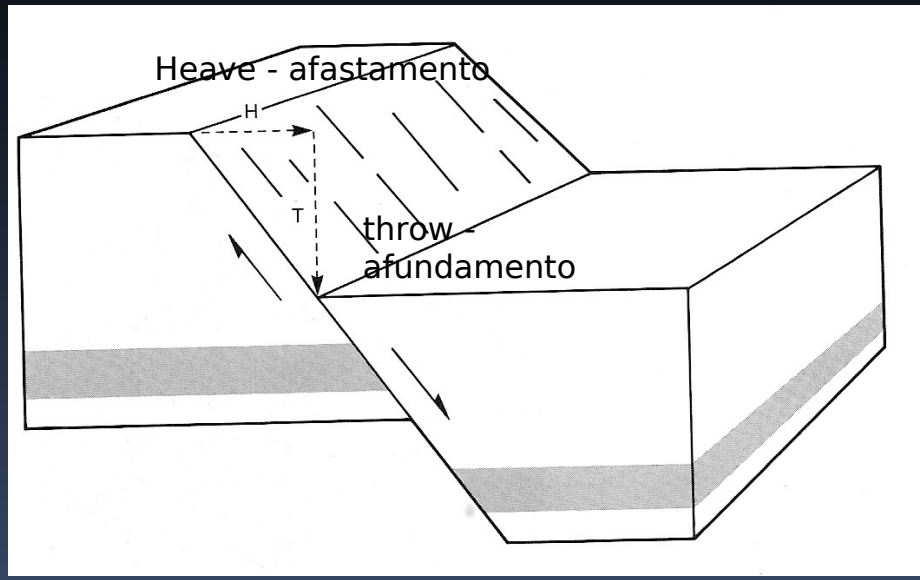


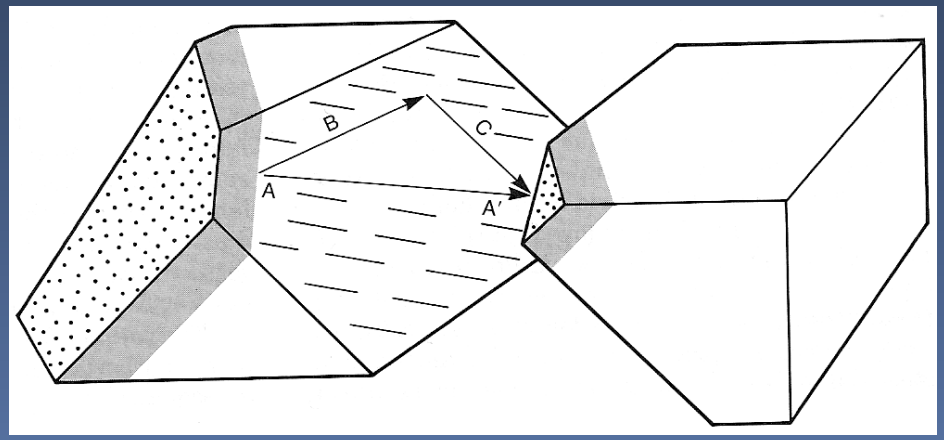
Juntas de



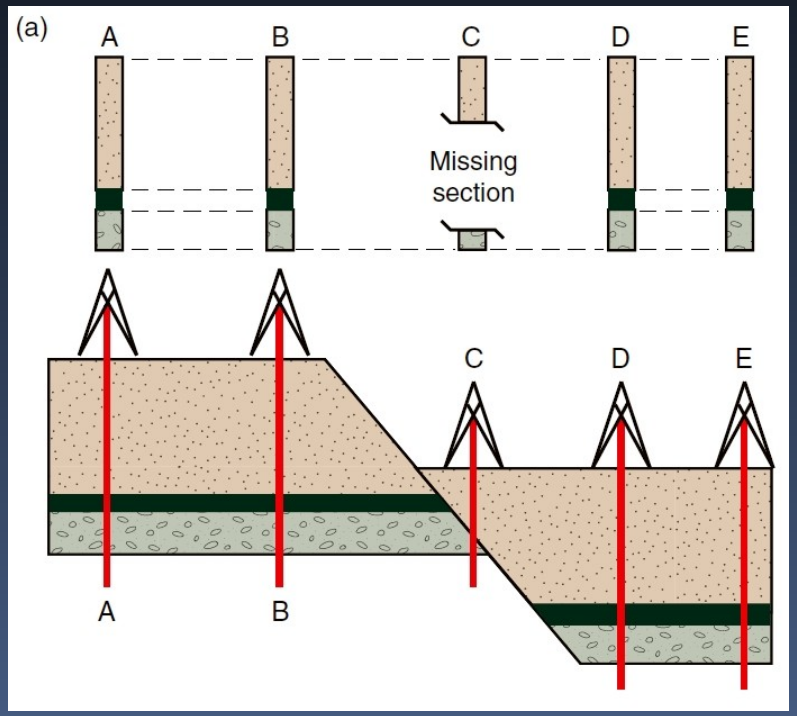
Falhas normais - geometria

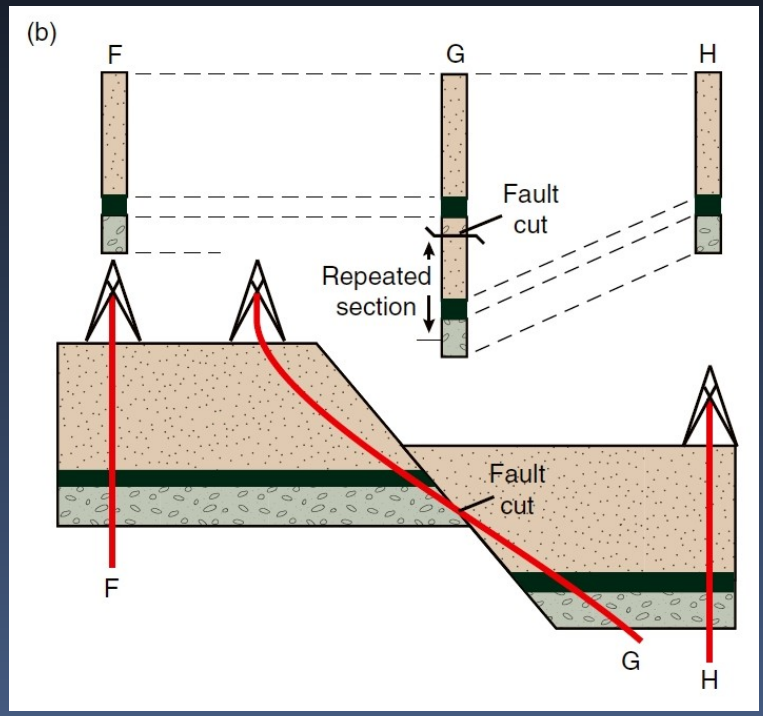






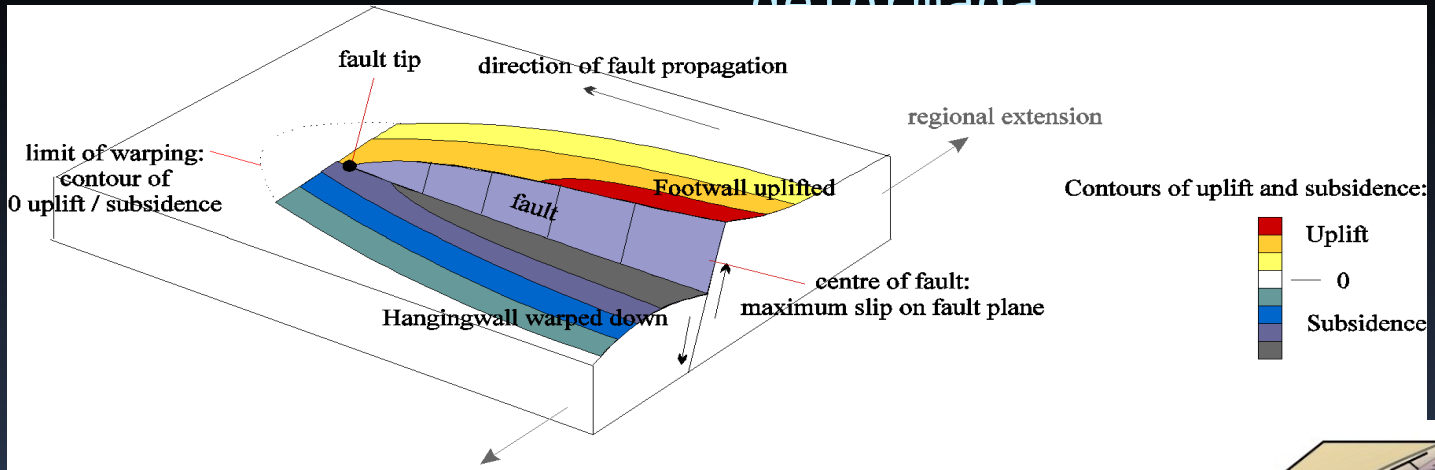
As falhas normais causam ausência de camadas em profundidade (Fossem, H., 2010)

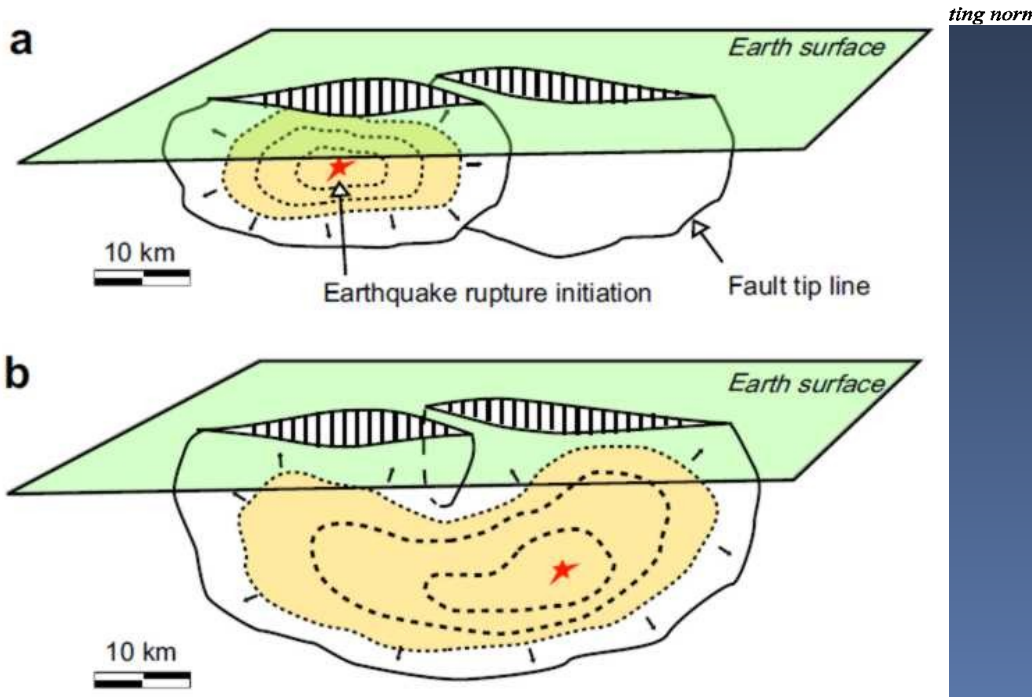




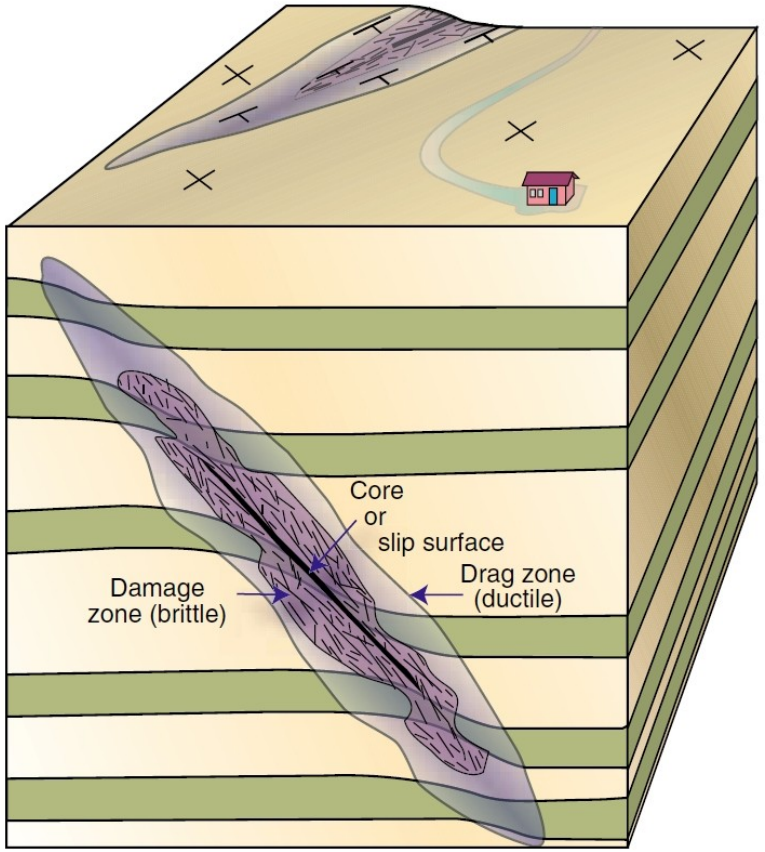
Mudança na orientação de um furo para compensar a ausência de camadas

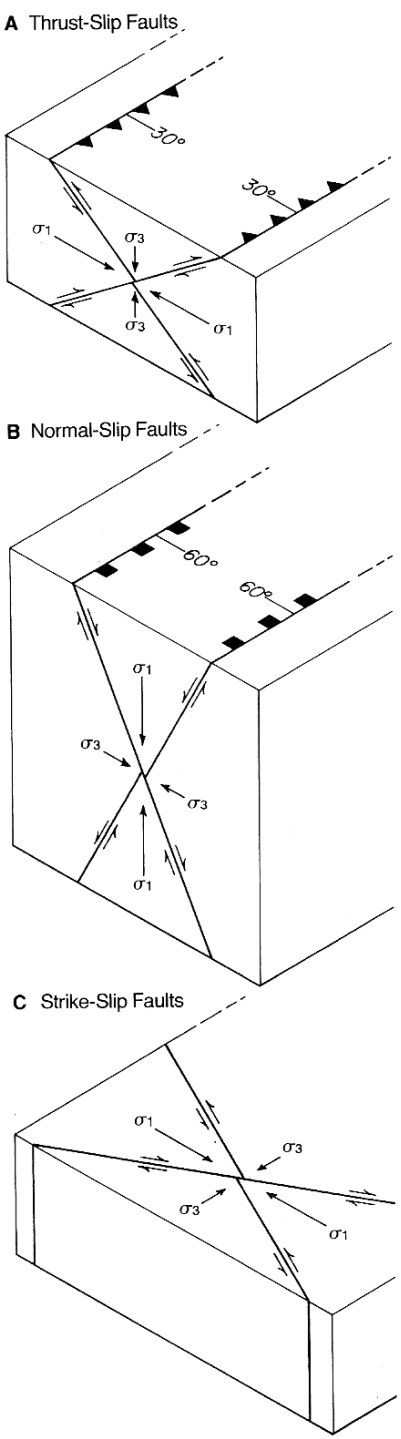
Anatomia de falhas normais: rejeito, crescimento e zona deformada





ting norn





Campos de tensões geradores de falhas – cisalhamento puro

Reversa

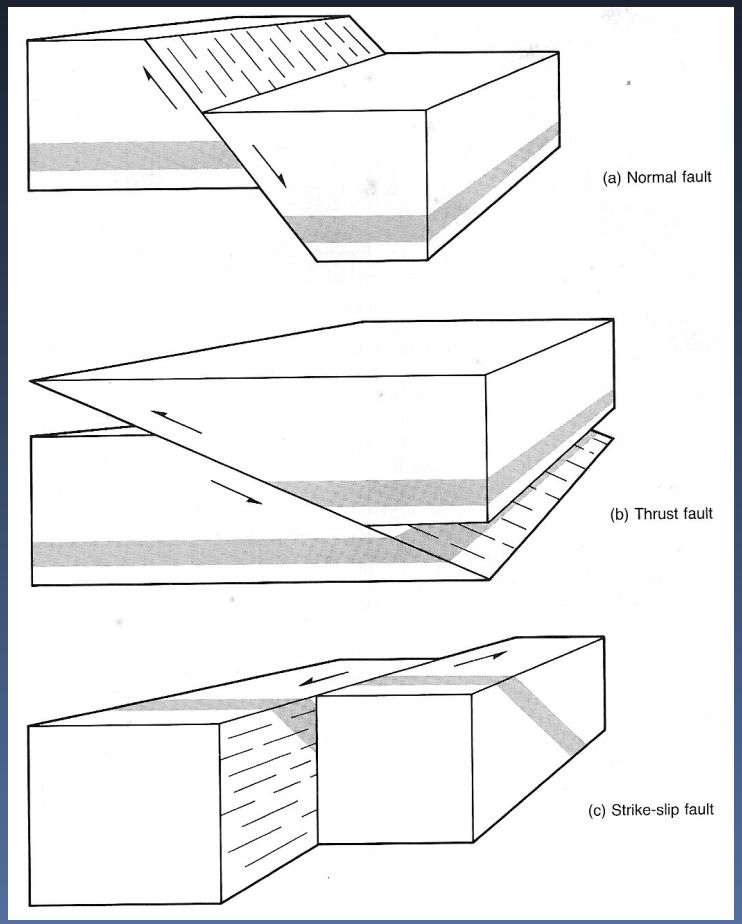
Normal

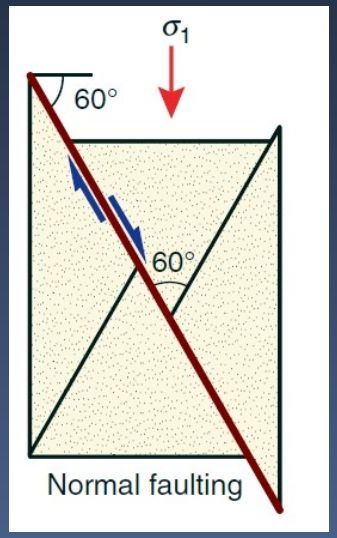
Modelo de Anderson (1942) – o eixo principal de tensões de maior magnitude → $\sigma 1$, se posiciona na bissetriz do ângulo agudo entre as falhas conjugadas geradas

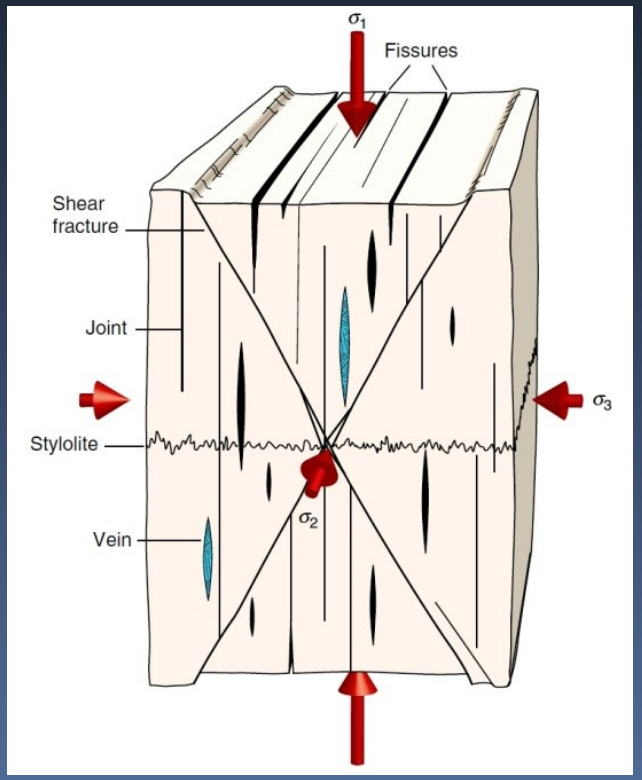
Direcional

Pressupostos – 1) material homogêneo 2) 3 eixos de tensões principais ortogonais entre si, com 1 vertical

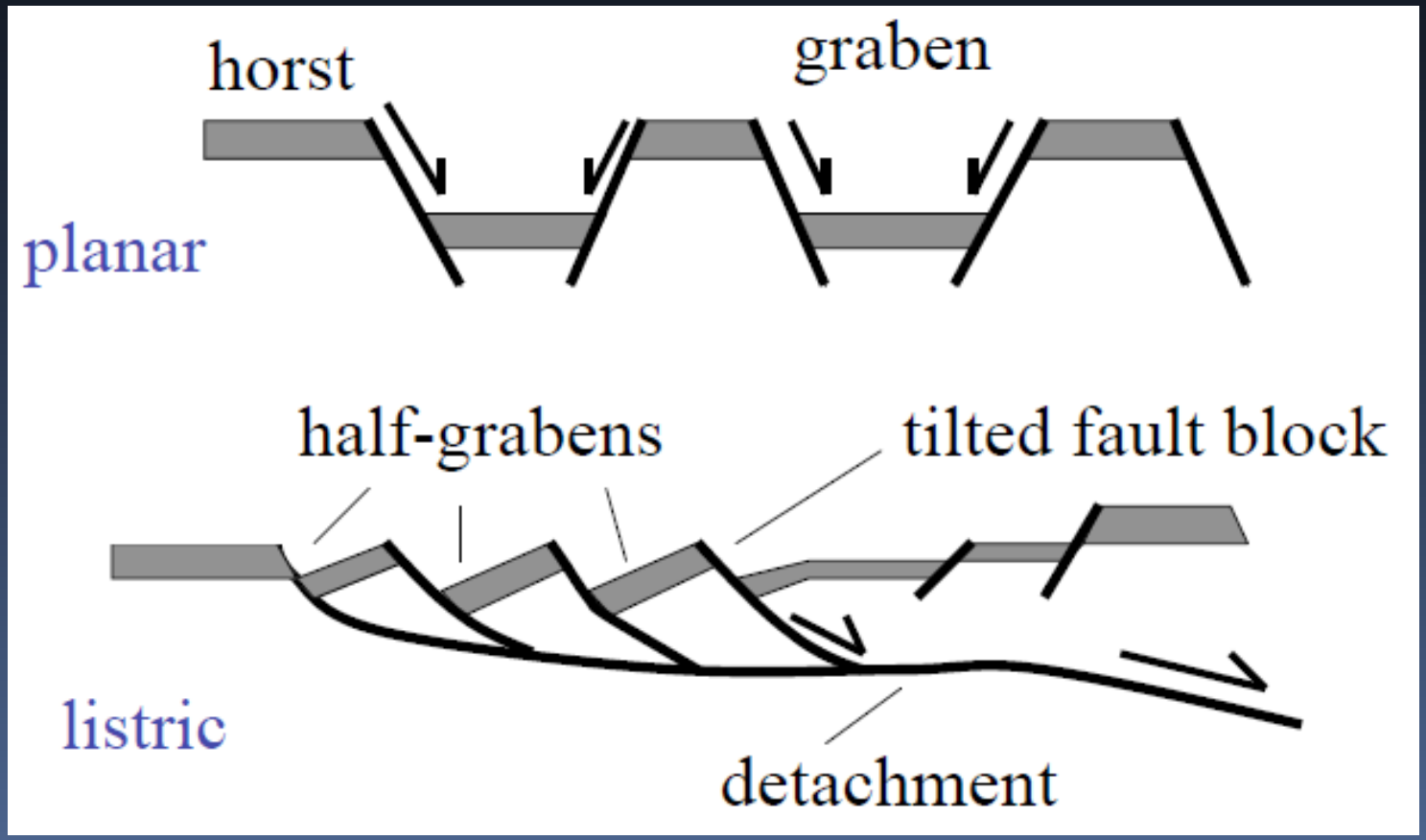
Falhas normais e a orientação dos eixos principais de tensão - cisalhamento puro Modelo de Anderson





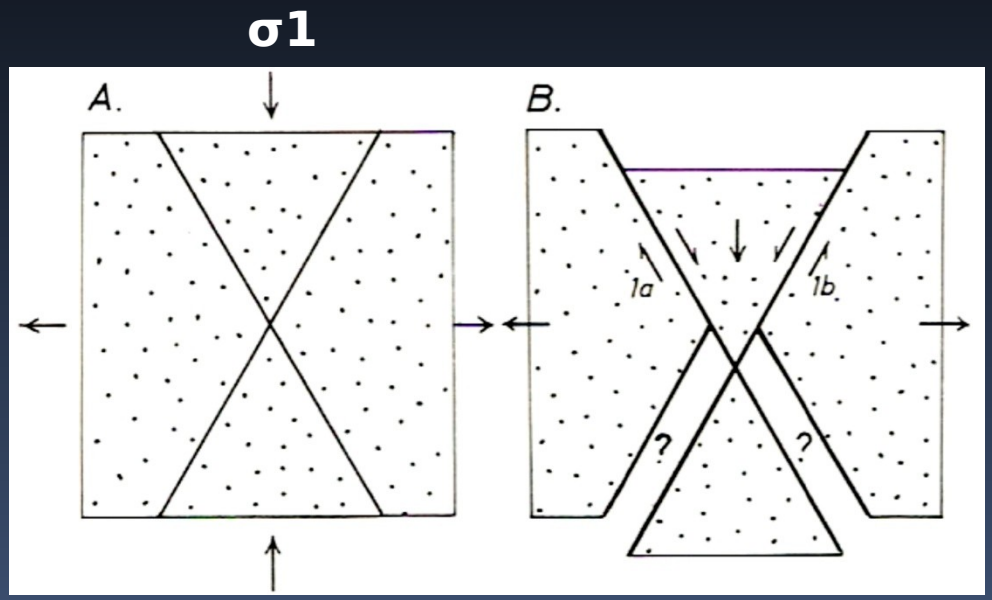


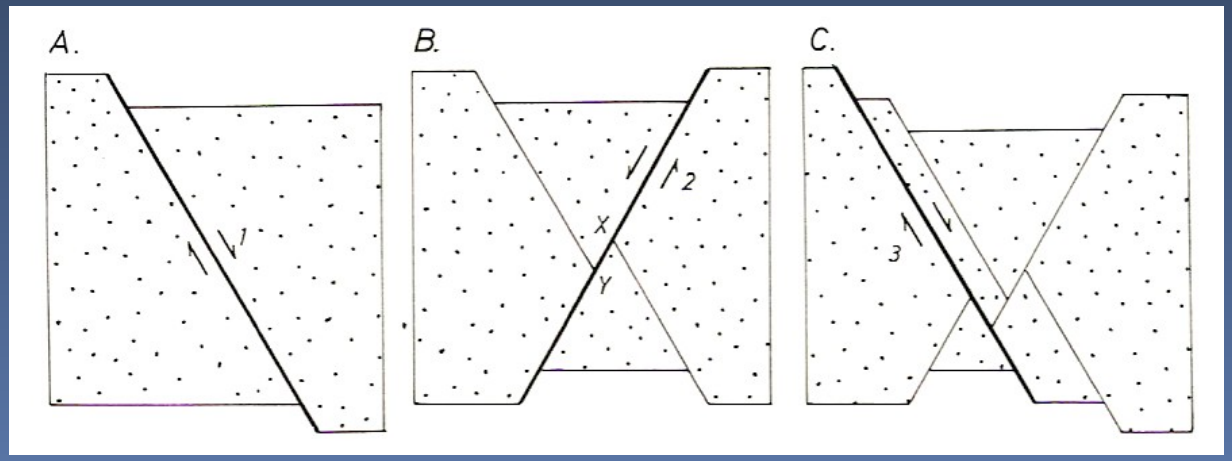
Falhas normais planares ou lístricas



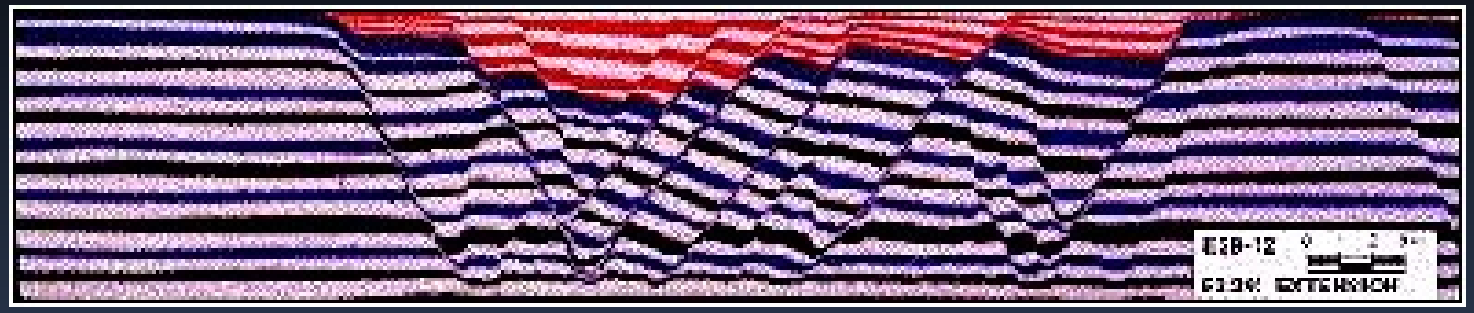
Falhas Normais Planares Não Rotacionais

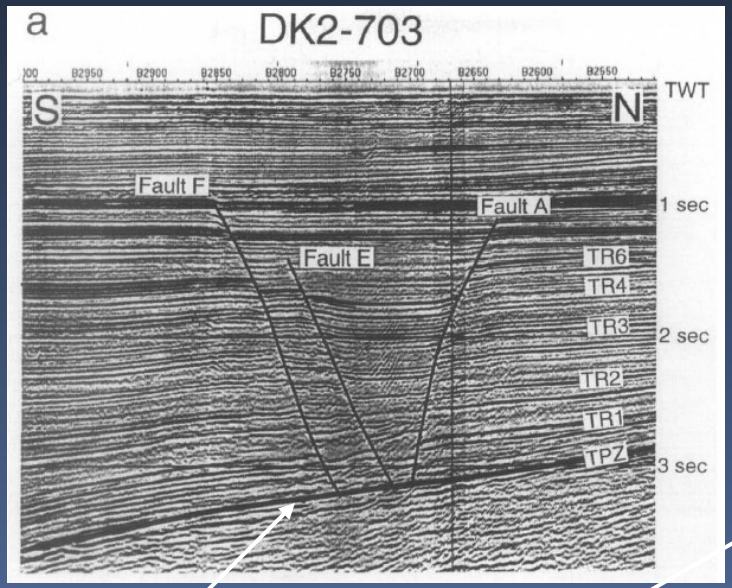
Problemas de espaço para o desenvolvimento de falhas normais planares não rotacionais

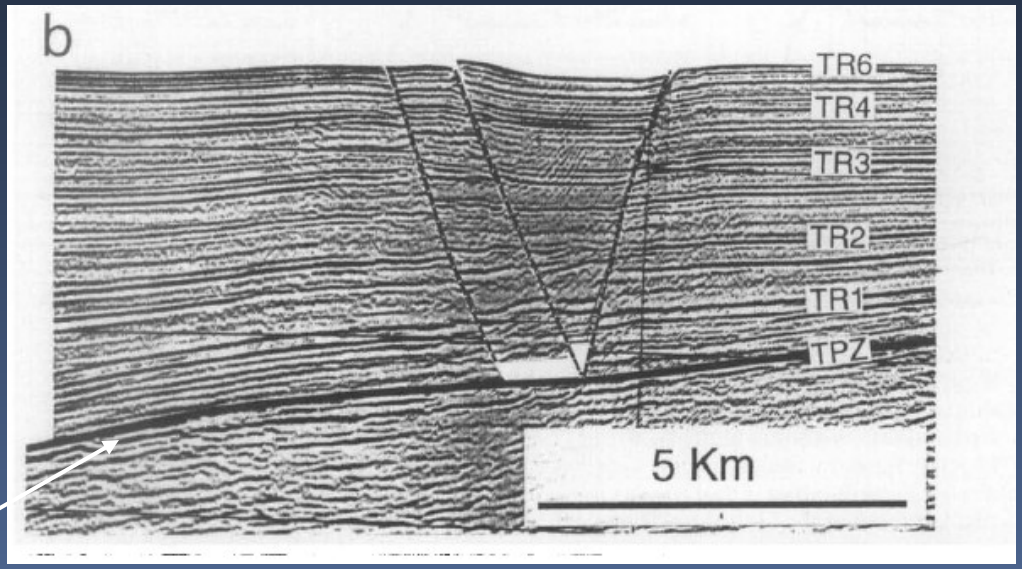




Falhas normais planares não rotacionais

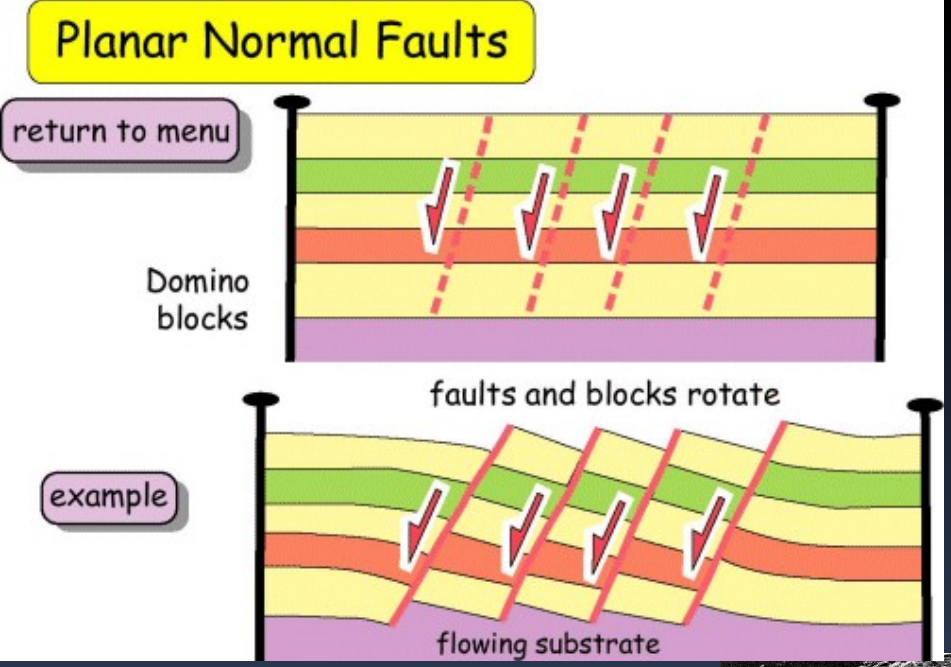






Superfície de descolamento

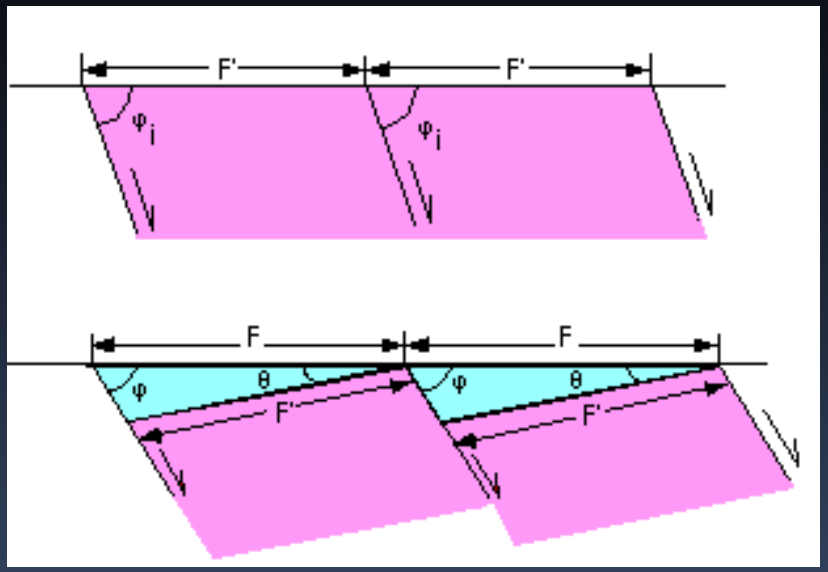
b – restituição de blocos em falhas normais planares não rotacionais – espaços vazios causados por compactação diferencial.



Falhas normais planares rotacionais em dominó

Os blocos rotacionados necessitam de um substrato plástico para absorver o movimento

Falhas normais planares rotacionais



Falhas normais planares rotacionais - blocos de falhas em dominó, no qual tanto as falhas como os blocos giram durante a distensão.

Falhas normais planares rotacionais em dominó

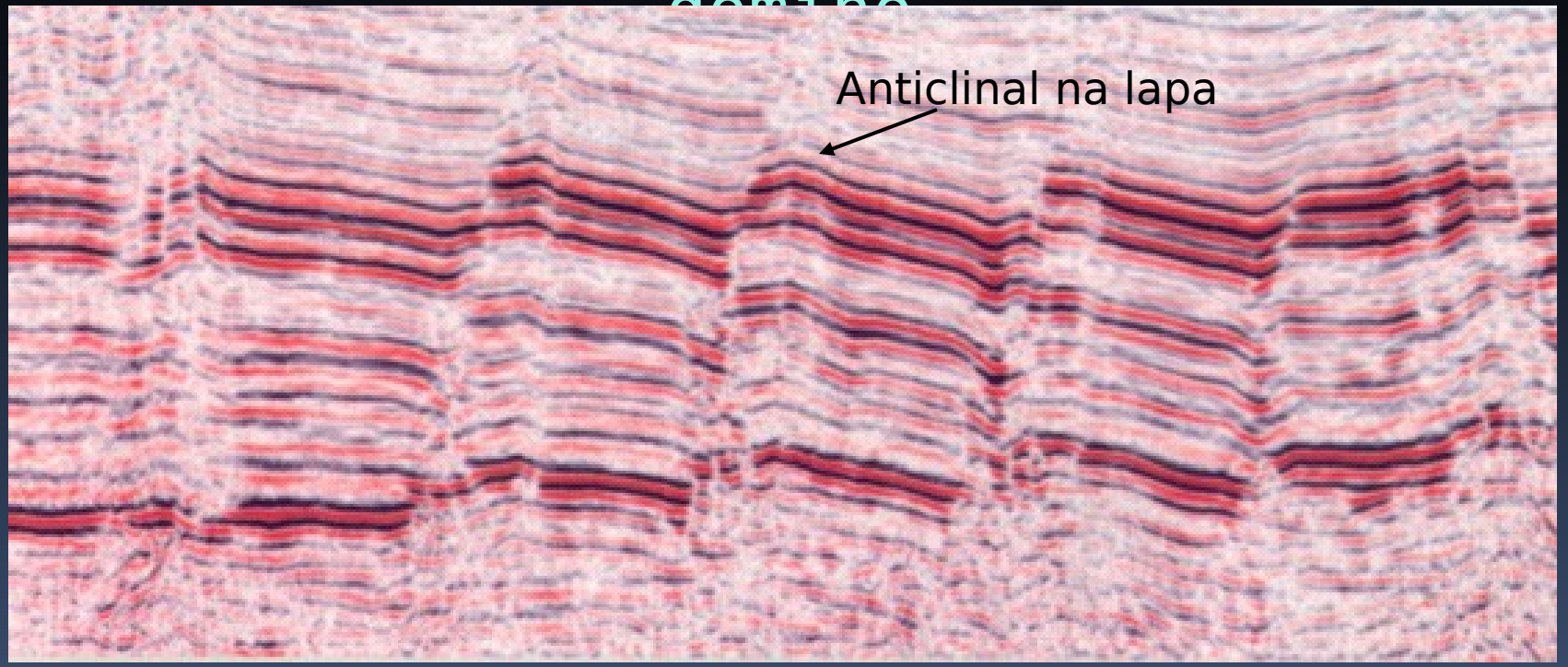
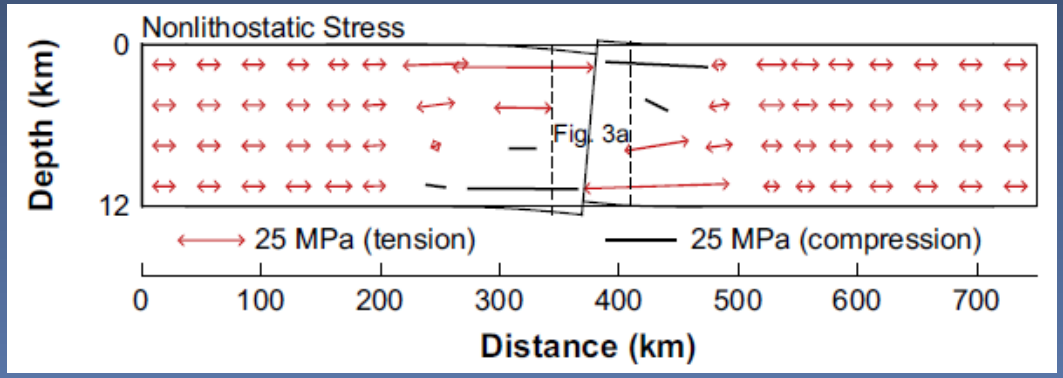
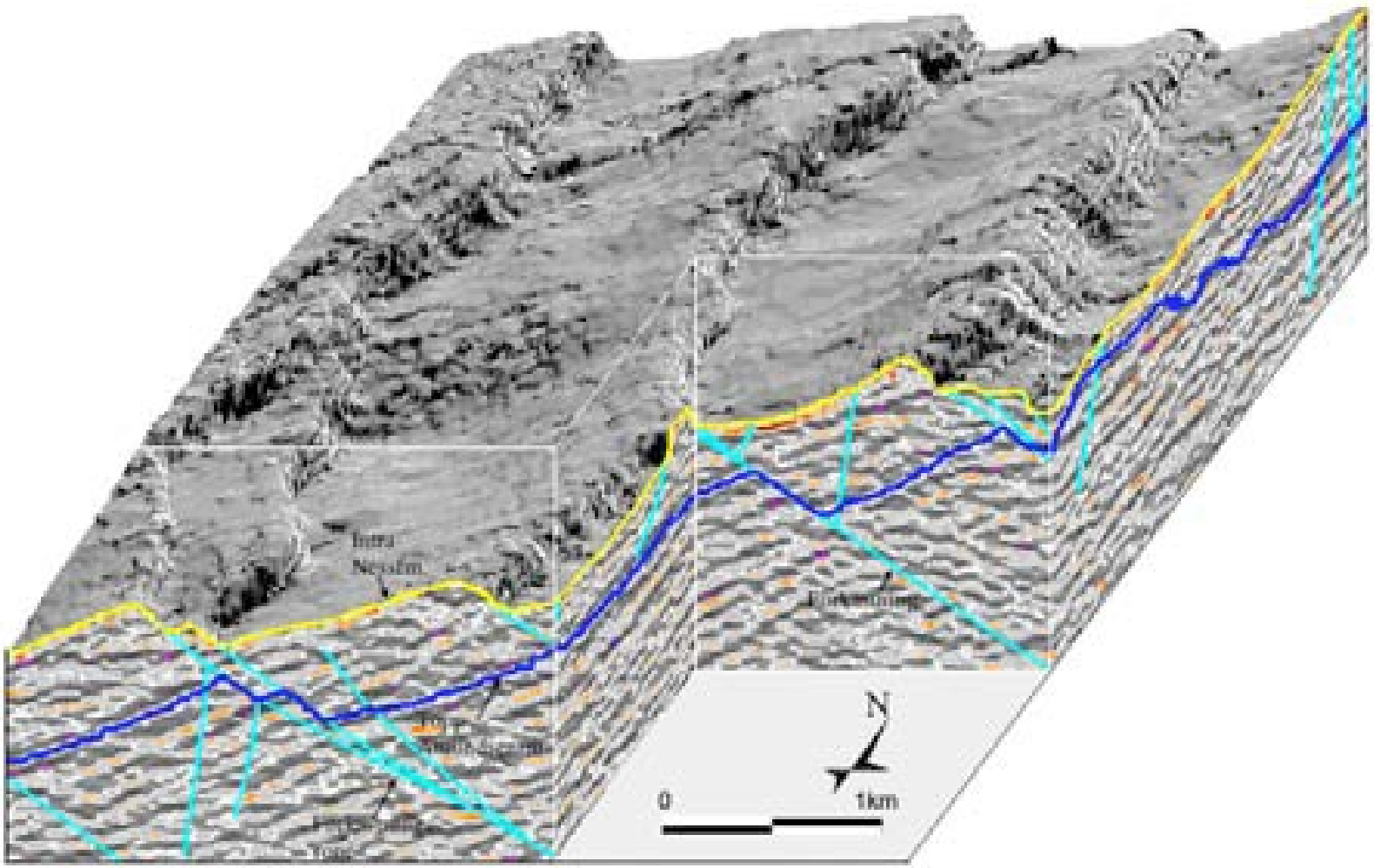
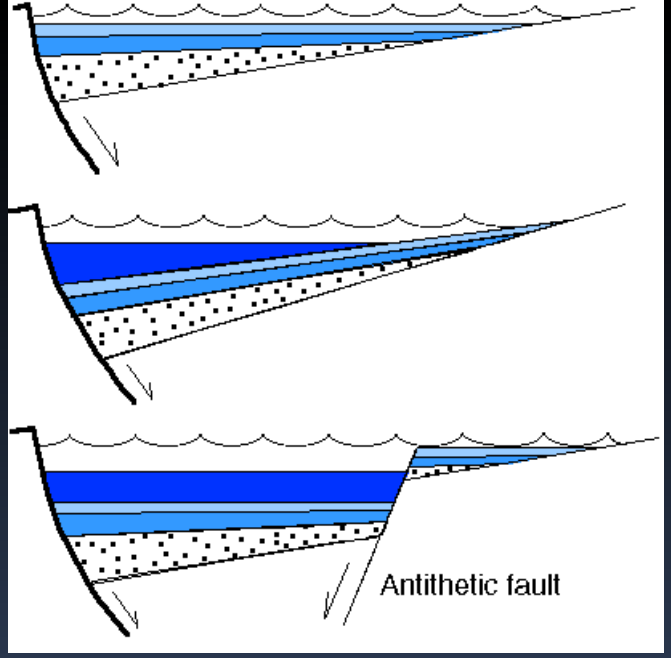


Imagem sísmica 3D mostrando falhas em dominó (*offshore* Líbano). Notar os anticlinais nos blocos altos e sinclinal nos blocos baixos.

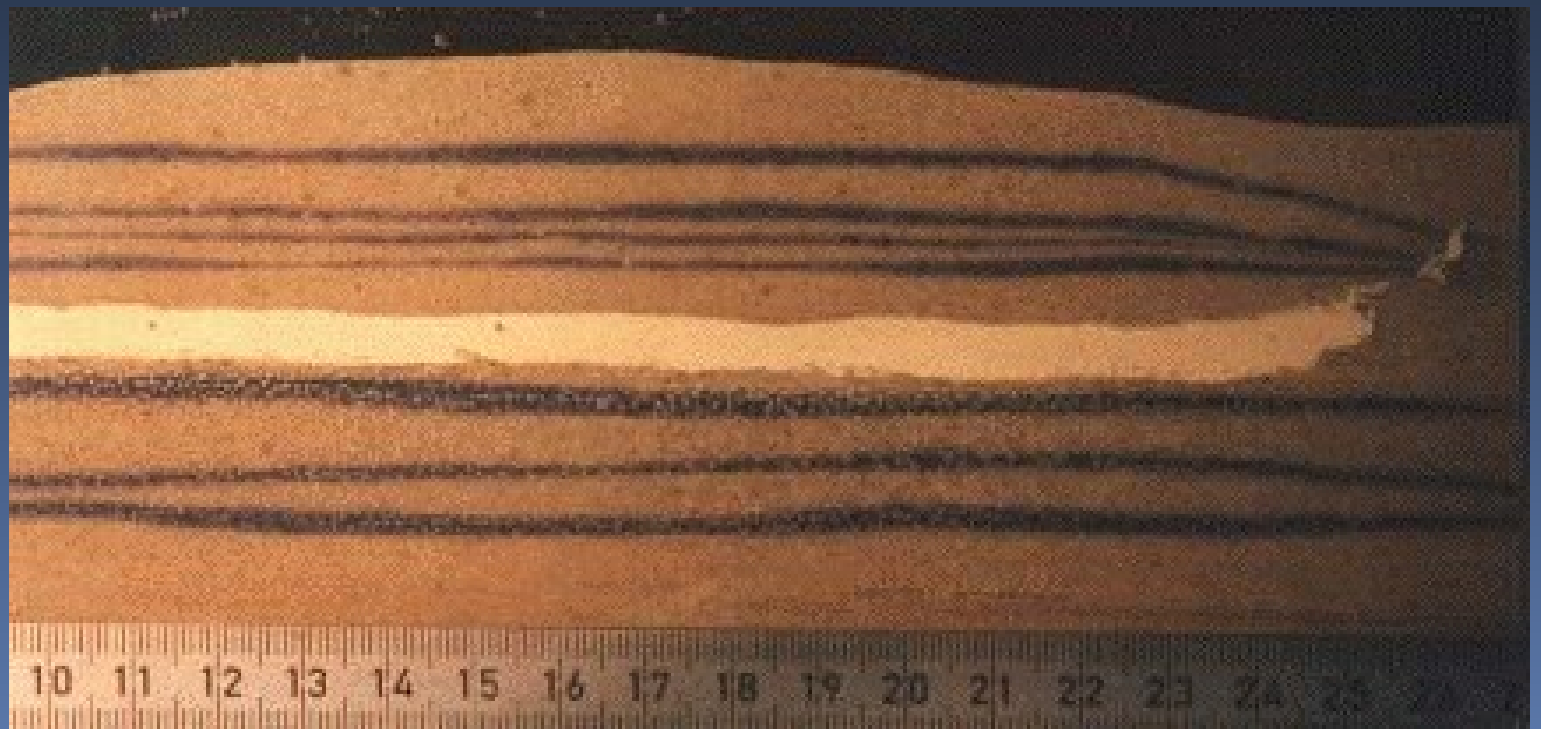




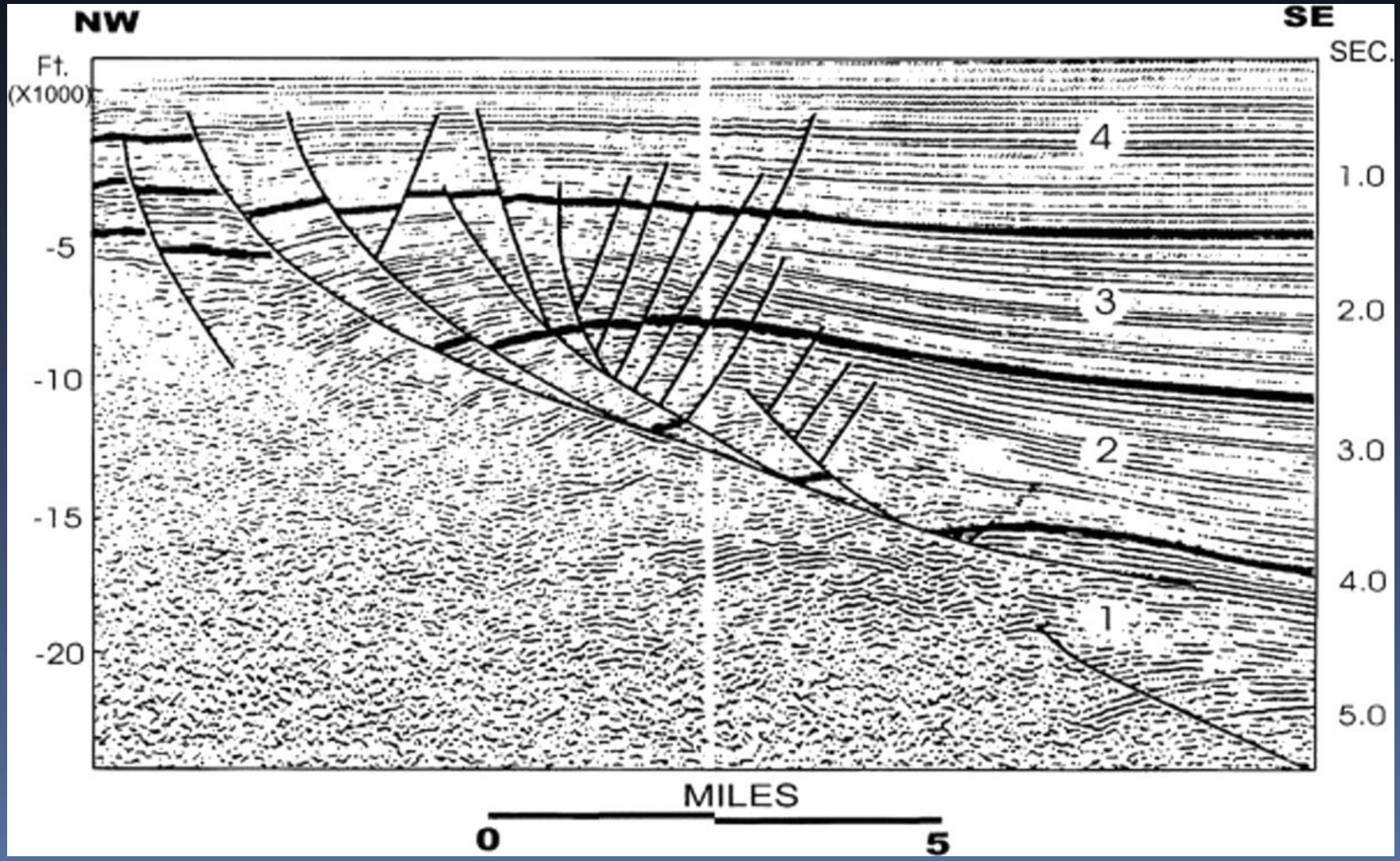
Falhas normais planares em dominó – bloco diagrama 3D com seções sísmicas e imagem do fundo oceânico por sonar de varredura lateral.



Falhas normais sintéticas e antitéticas- observar o depocentro junto da margem ativa (tectônica) e não na flexural

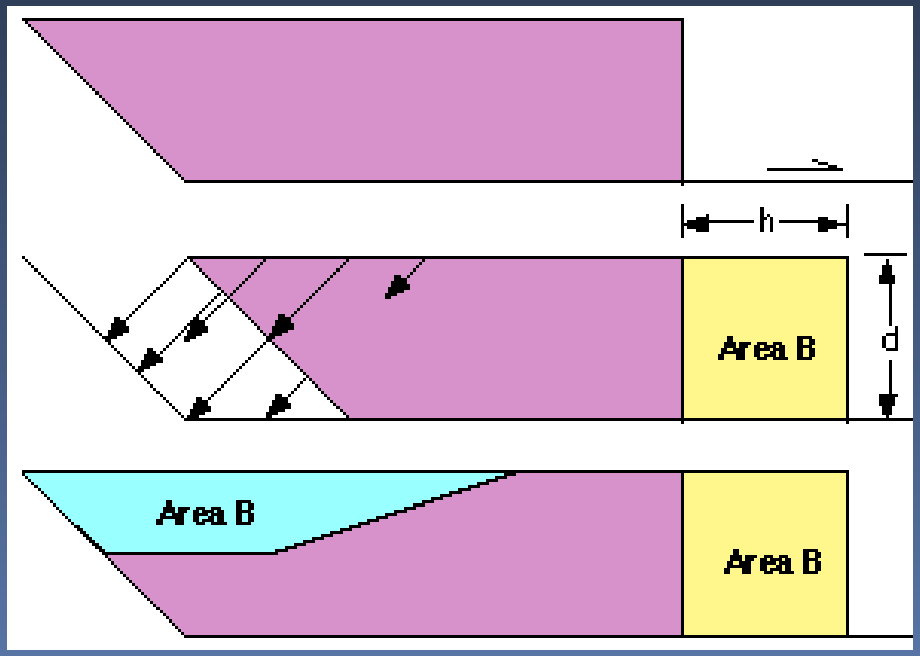


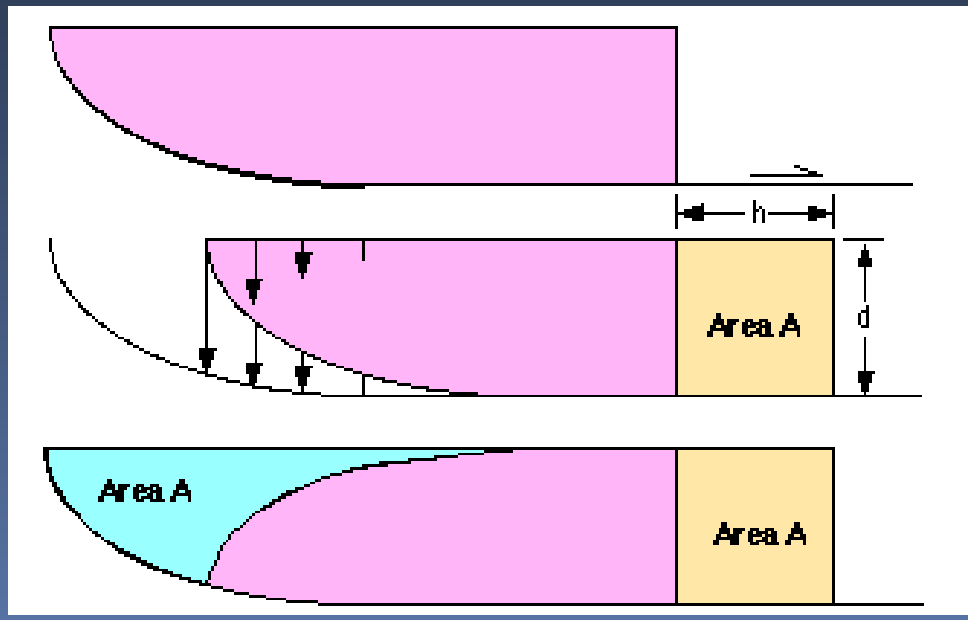
Falhas normais sintéticas e antitéticas



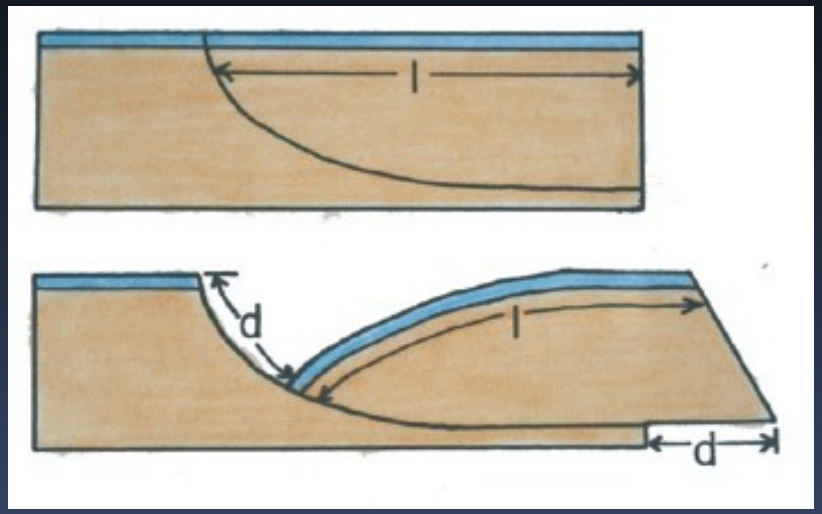
Falhas lístricas com superfície de descolamento subhorizontal.

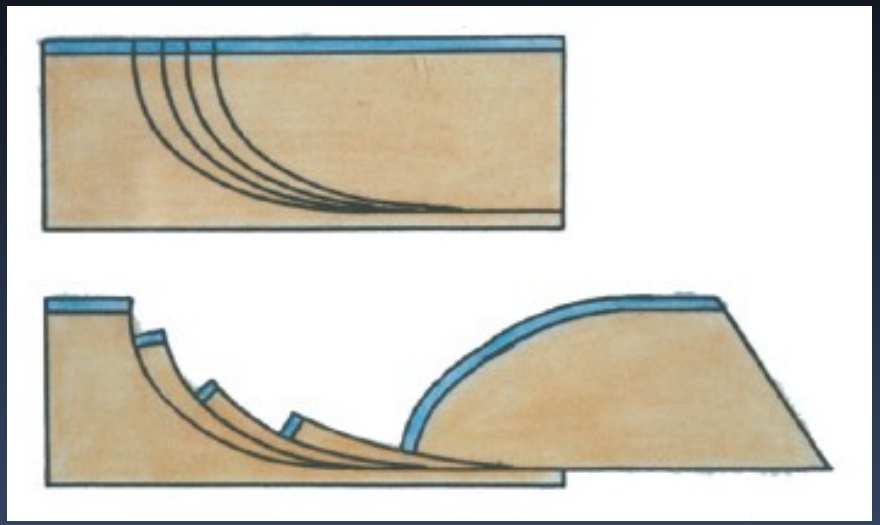
O deslocamento horizontal (h) na superfície de descolamento gera um espaço entre a capa *(hanging wall)* e a lapa *(footwall)* que é preenchido pelo colapso da capa segundo falhas normais antitéticas com mergulho de 45º (esquerda), ou dobra anticlinal (direita).

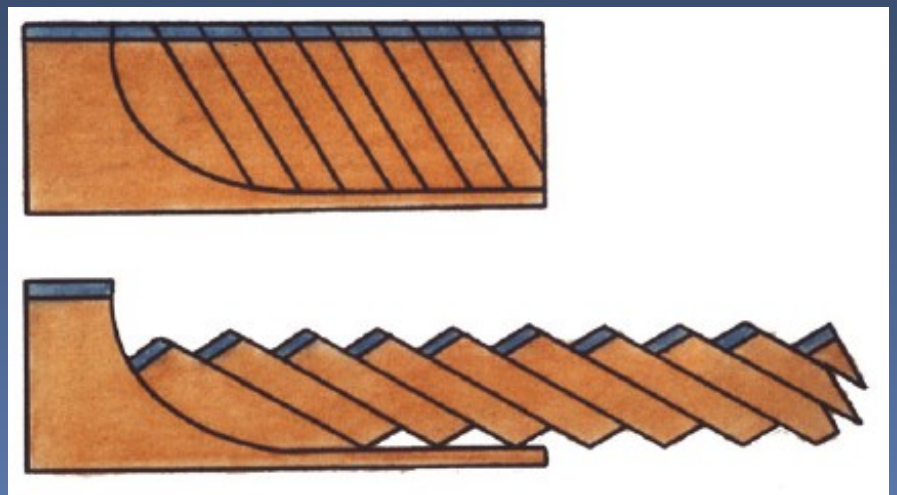




Falhas lístricas com superfície de descolamento subhorizontal.

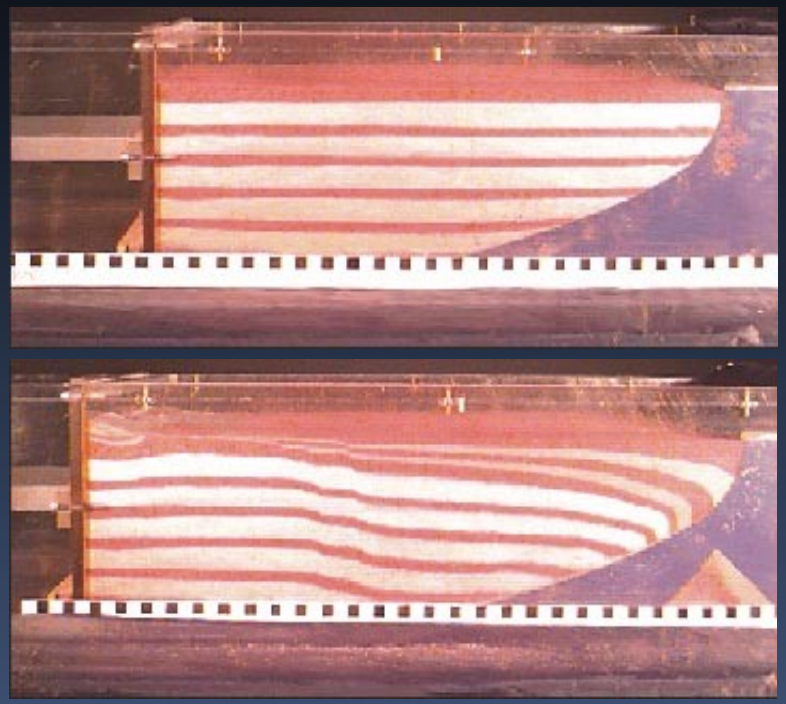


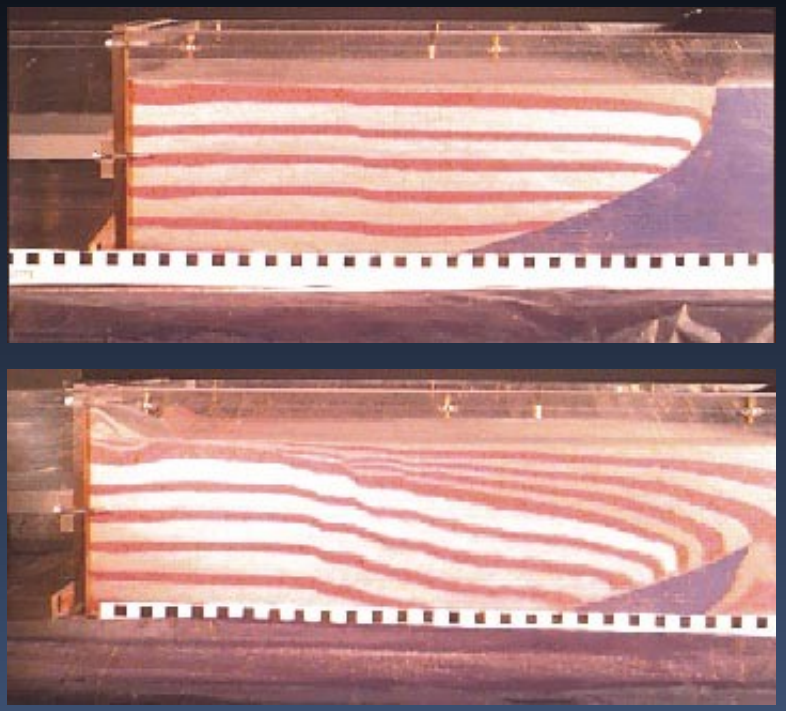


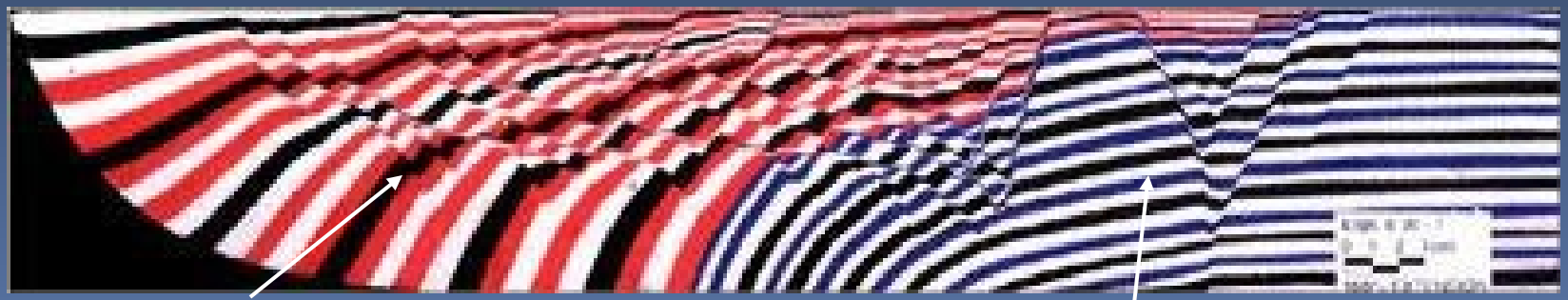


Lístrica + dominó

Falha lístrica em caixa de areia com desenvolvimento de anticlinal de *roll-over* ou anticlinal de compensação



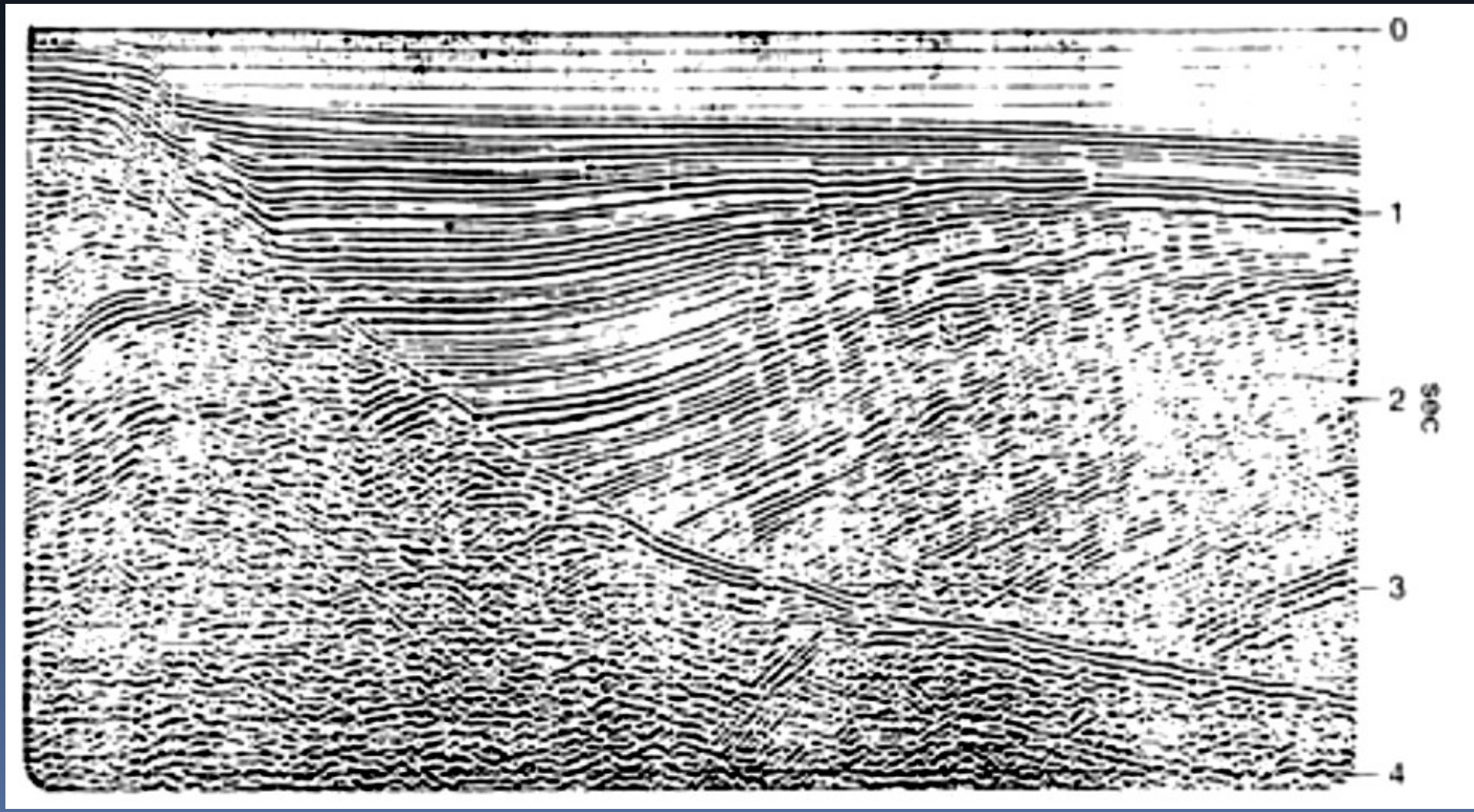




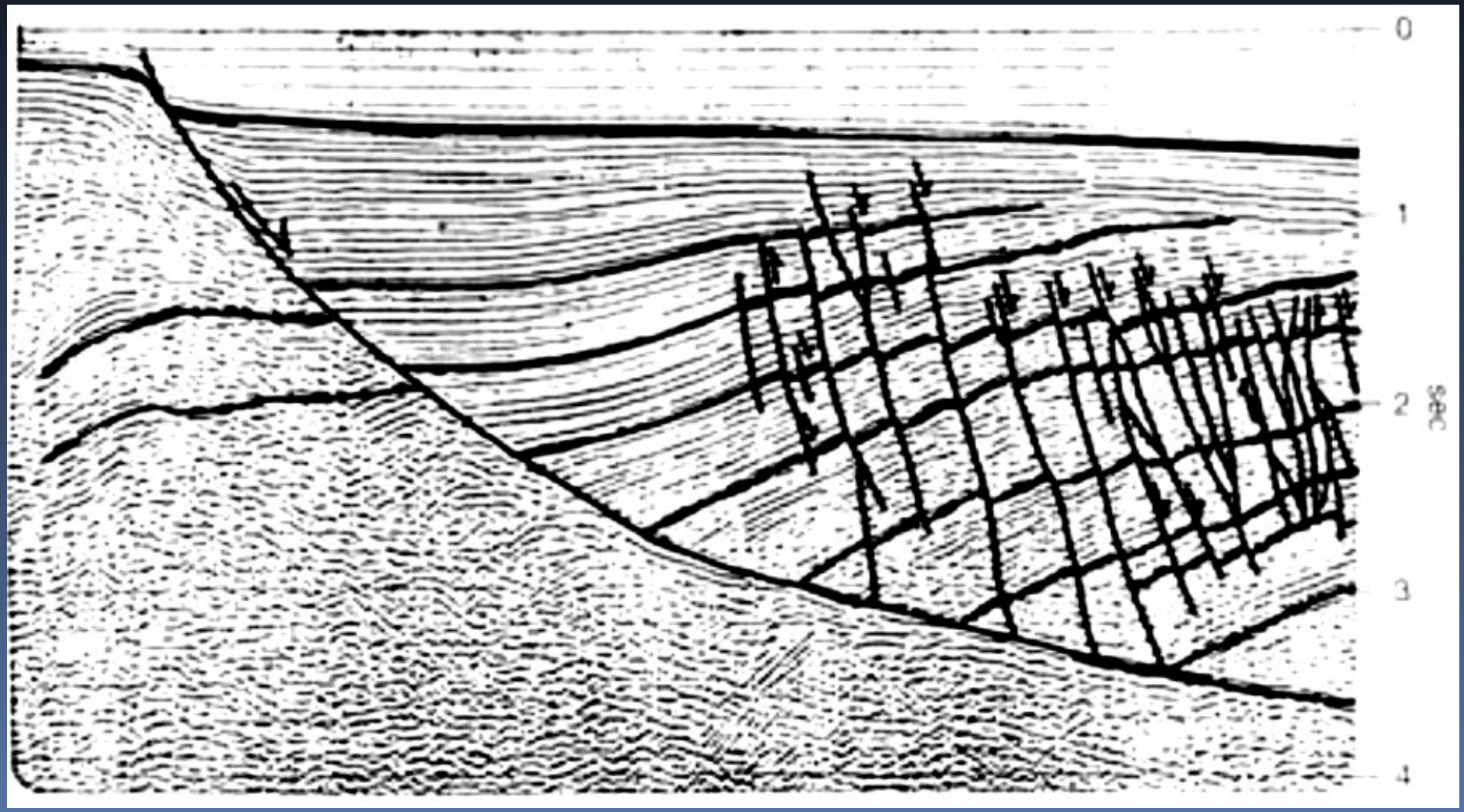
Deposição sintectônica

Deposição pré-tectônica

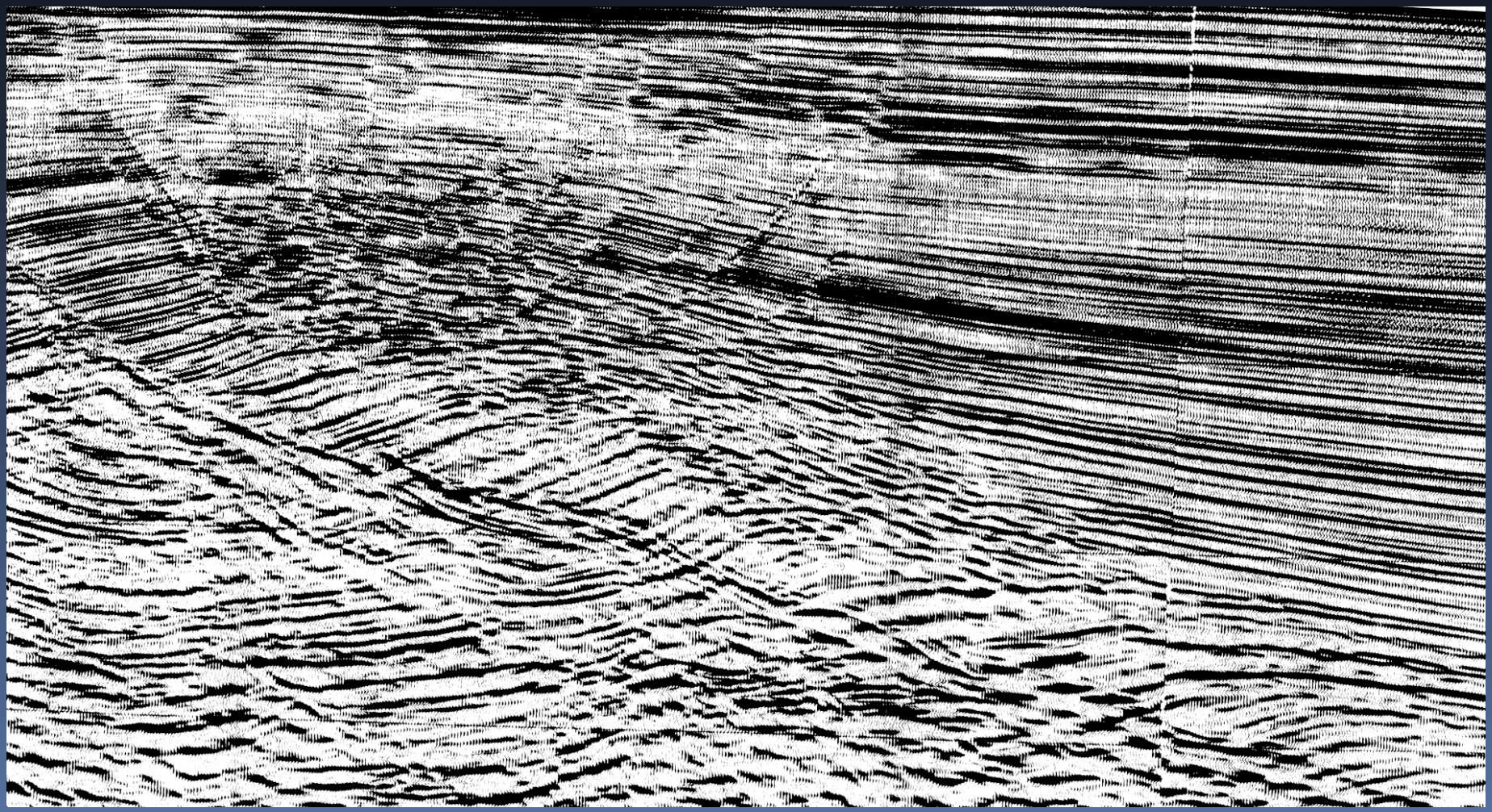
Falhas normais sintéticas em anticlinal de compensação *(roll-over anticlinal)*



Falhas normais sintéticas em anticlinal de compensação *(roll-over anticlinal)*



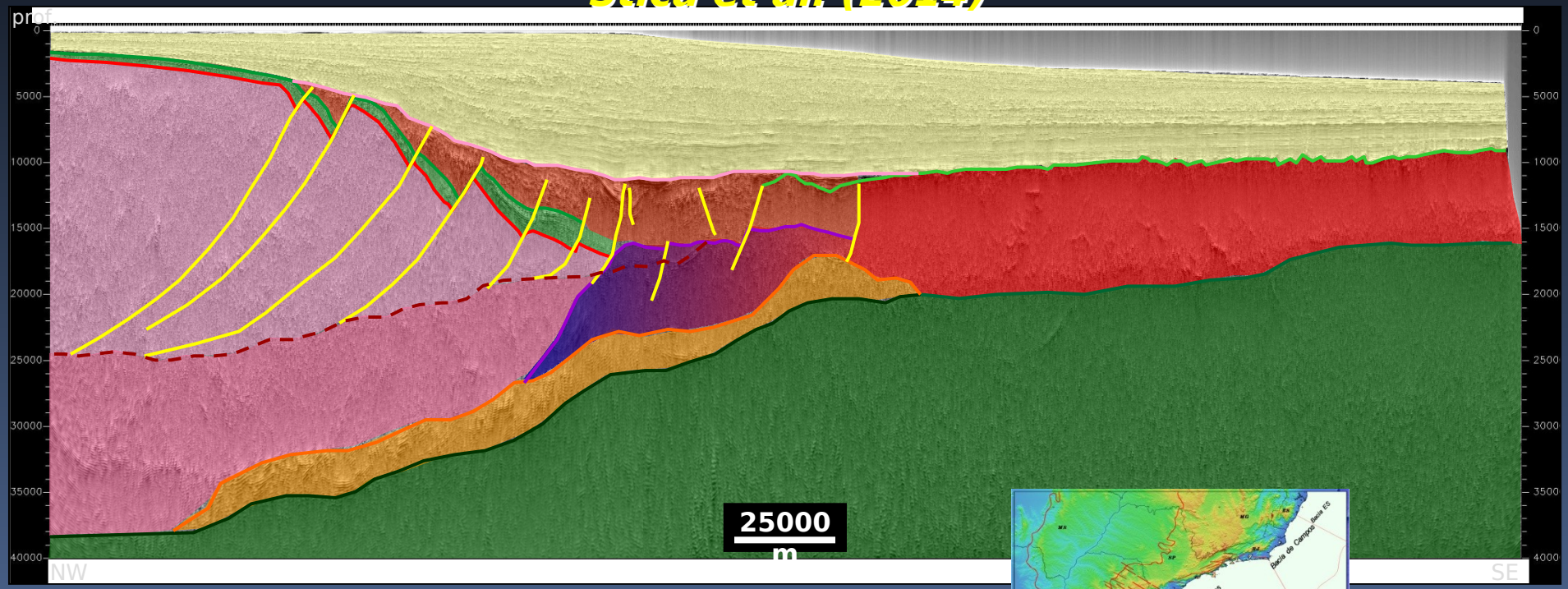
Falhas normais sintéticas e antitéticas em anticlinal de compensação *(roll-over anticlinal)*



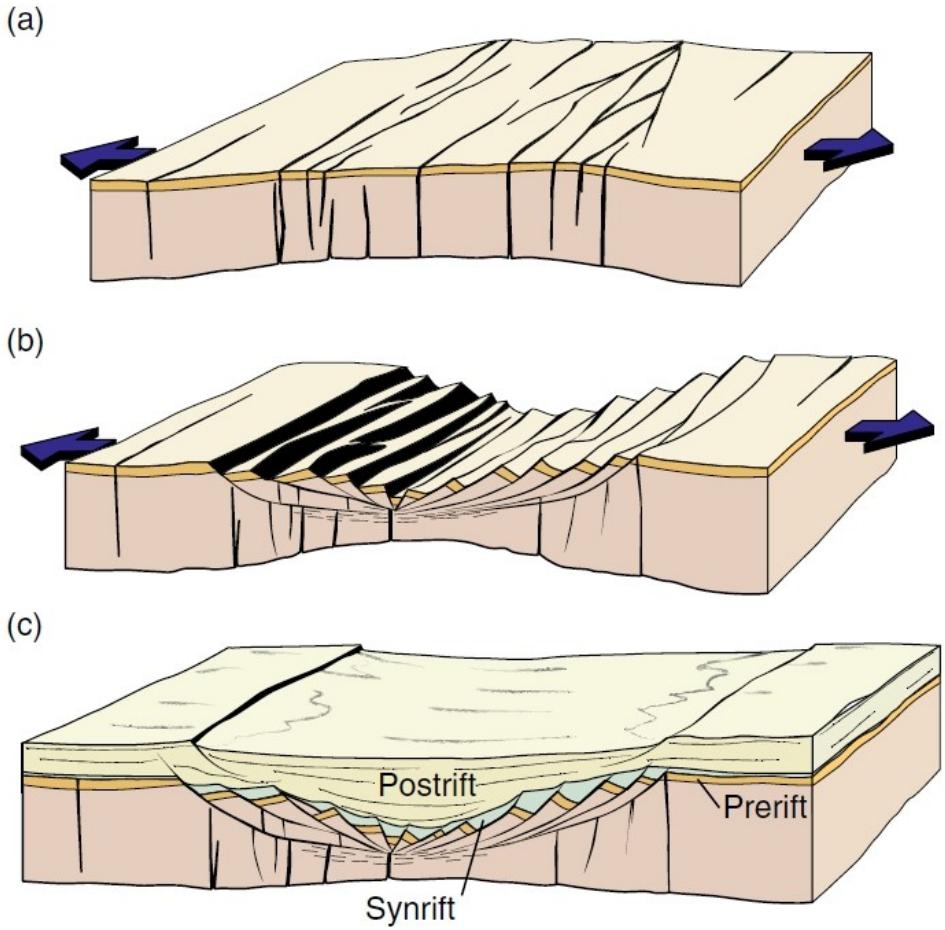
Interpretação Sísmica Margem Vulcânica Pelotas – Falhas antitéticas e descontinuidade de Conrad

Bacia de Pelotas - Sul

Stica et al. (2014)

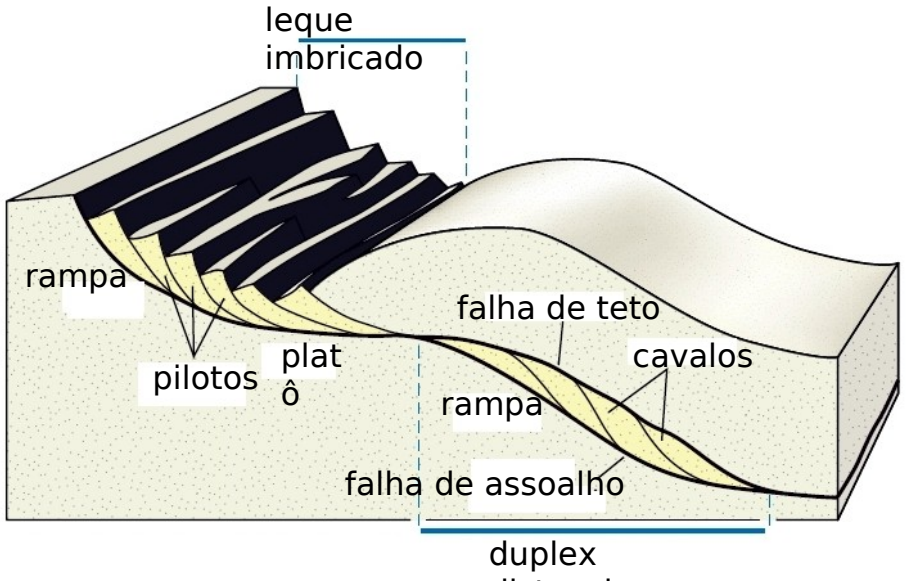


Processamento TecVA Petrobras

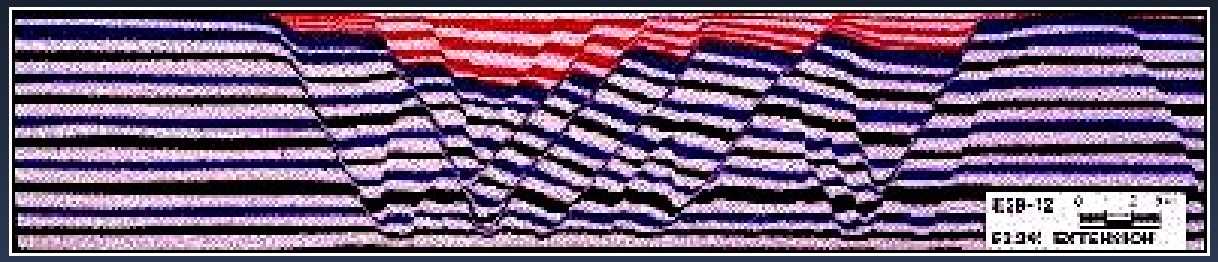


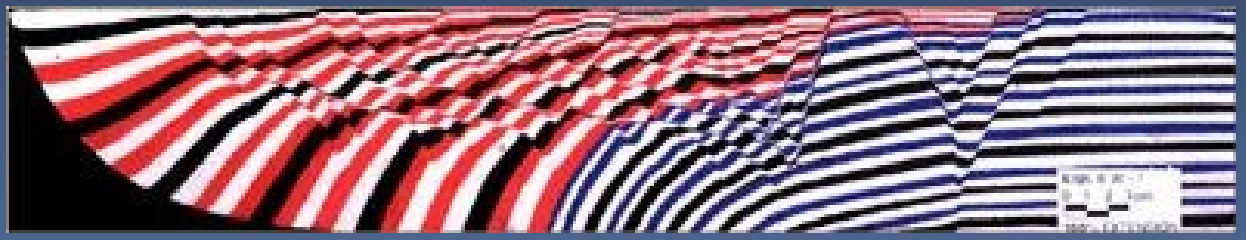
Estagios de formação de um rifte: a) pré-rifte – distensão suave, fraturas profundas podem ser conduto de magmatismo, b)sin-rifte – estiramento intenso, formação das falhas principais, c) pós-rifte – subsidência e sedimentação. Podem ocorrer falhas por compactação. (Fossem, H., 2010)

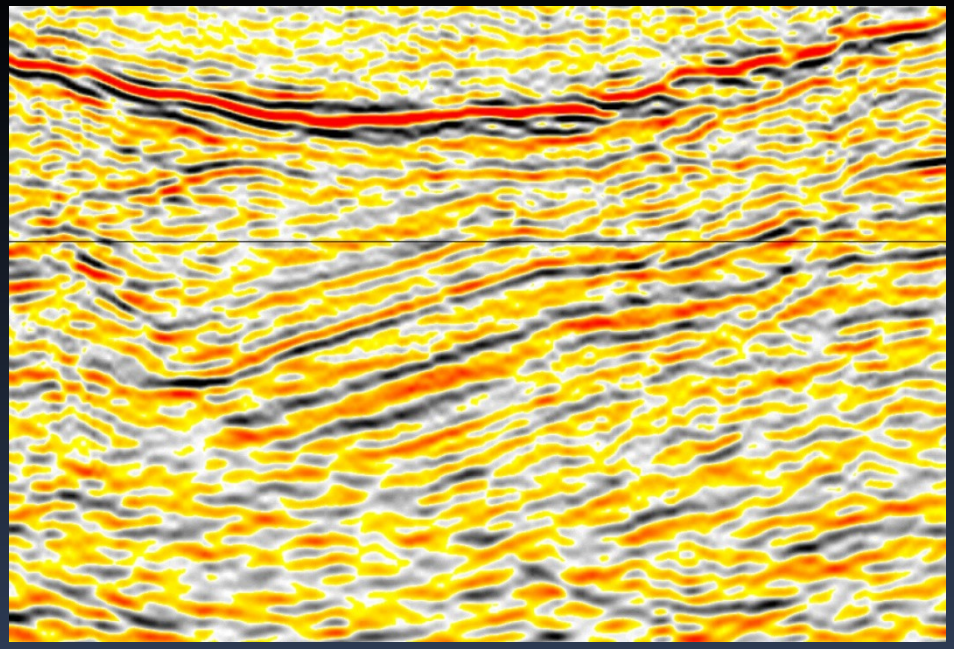
Leque de estruturas distensivas imbricadas e formação de duplexes distensivos e dobramento.

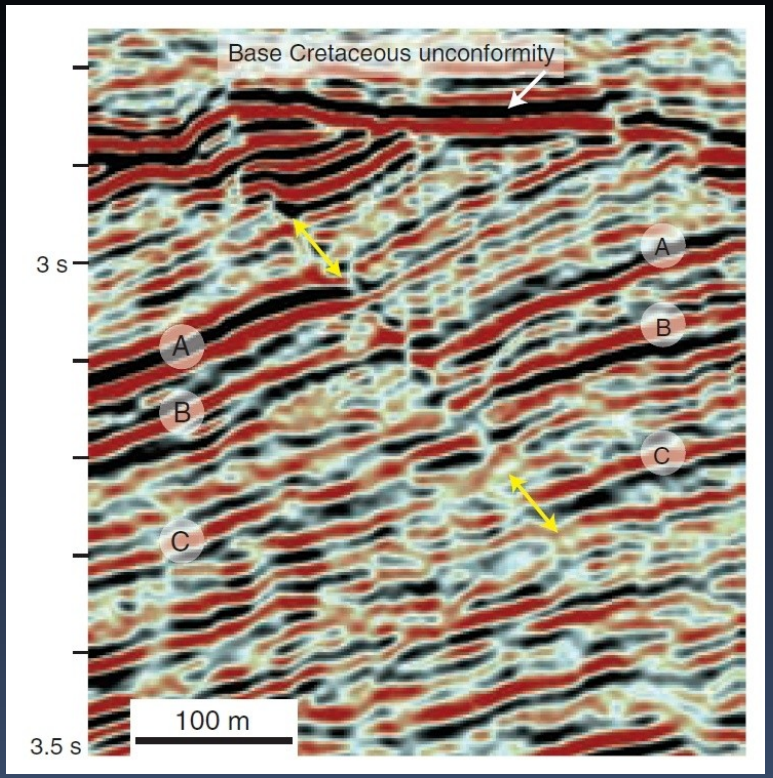


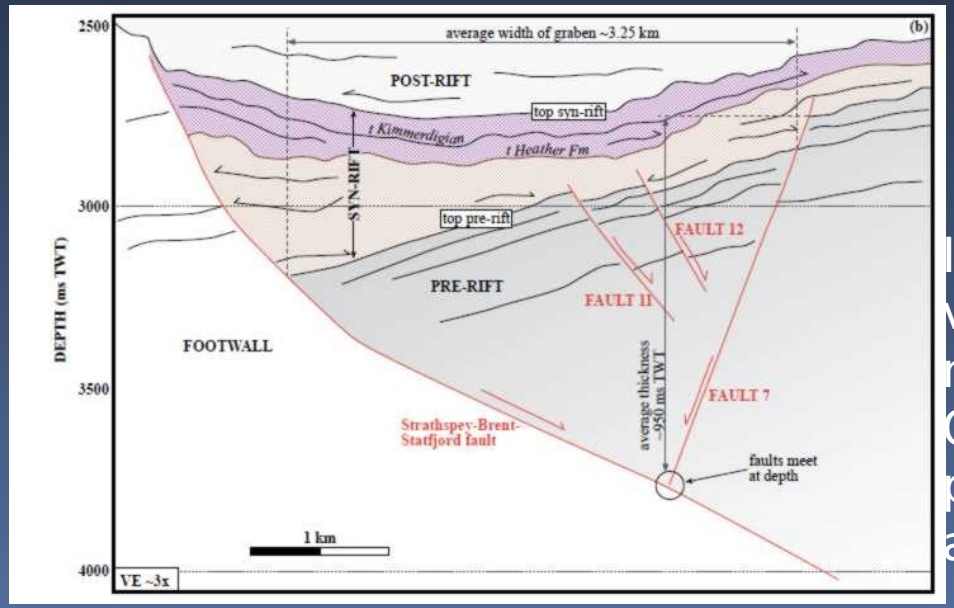
Extensão em caixa de areia, com assimetria aumentando de cima para baixo







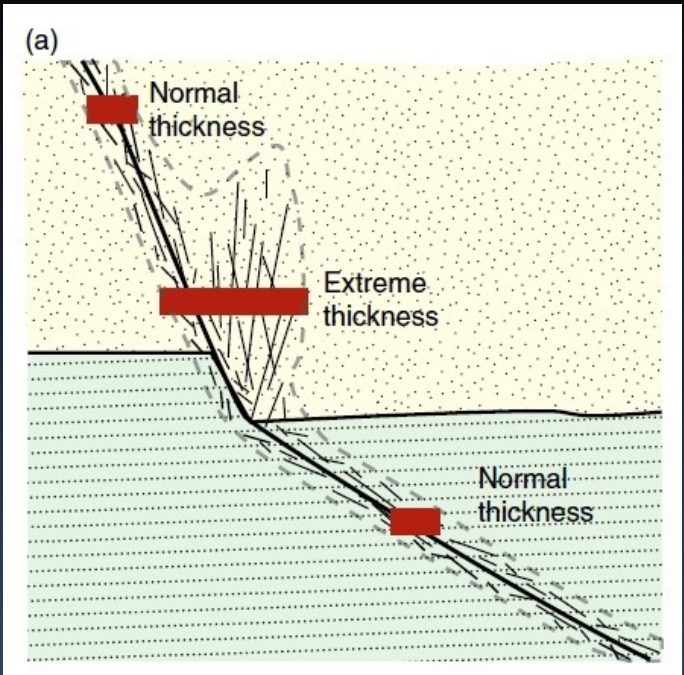


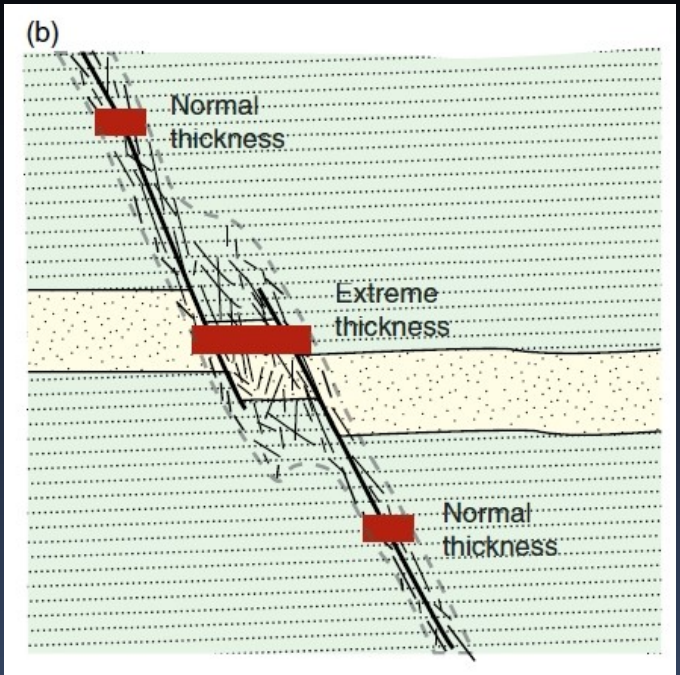


Importante: o plano de falha muitas vezes não é claramente identificado na sísmica.
O deslocamento das camadas – parâmetro estrátigráfico é que indic a posição do plano de falha. Linha 3

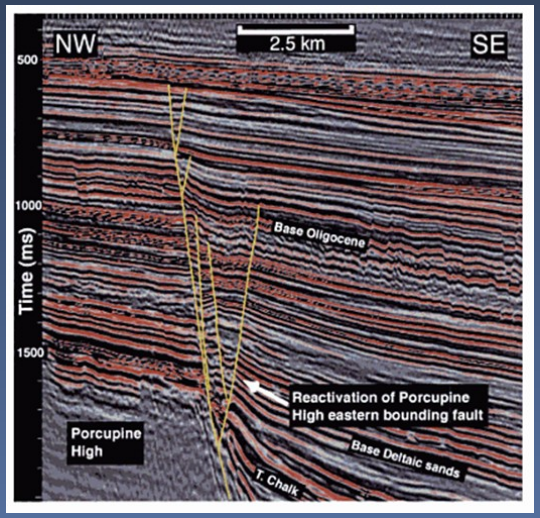
Falhas sintéticas e antitéticas em anticlinal de *roll-over* ou anticlinal de compensação (McLeod *et al*.

Zona de deformação é mais intensa na capa



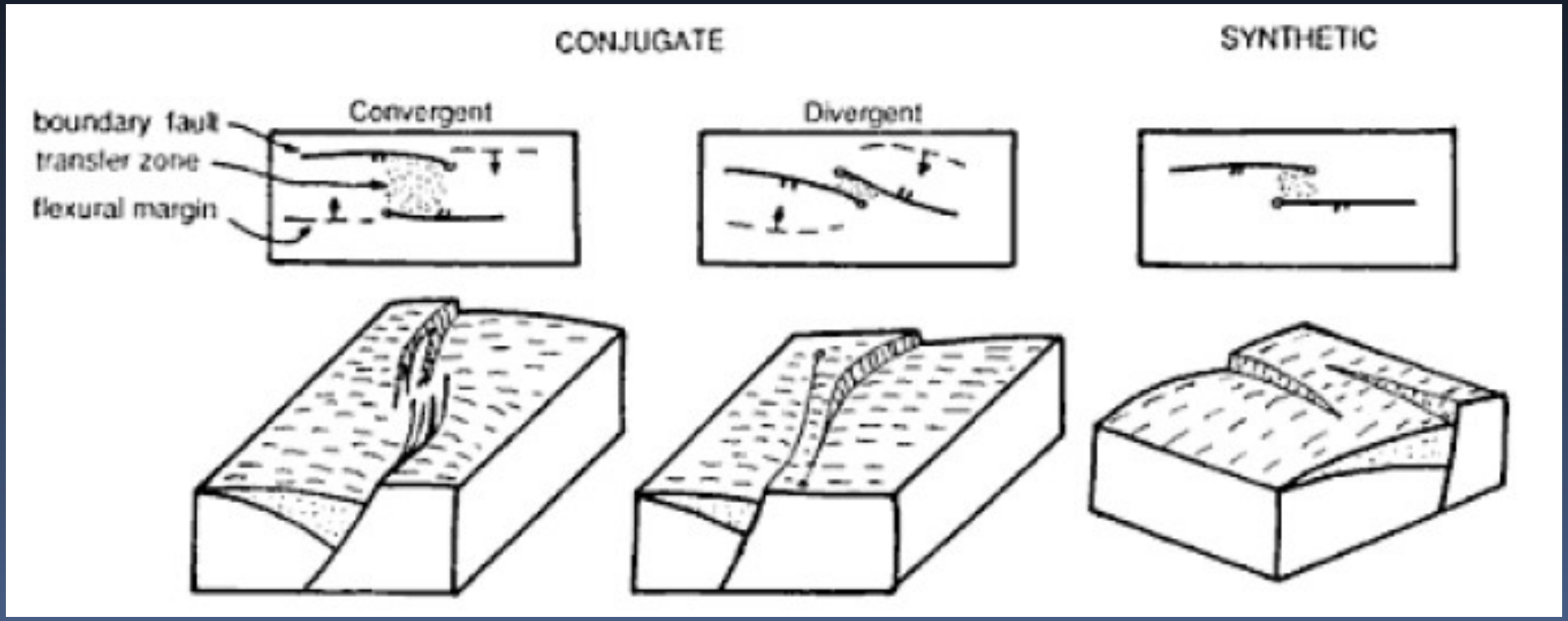


Variação da espessura da zona afetada pela falha está associada a mudanças no mergulho do plano de falha (a) ou a zonas de ligação entre segmentos distintos (b) (Fossem, 2010)

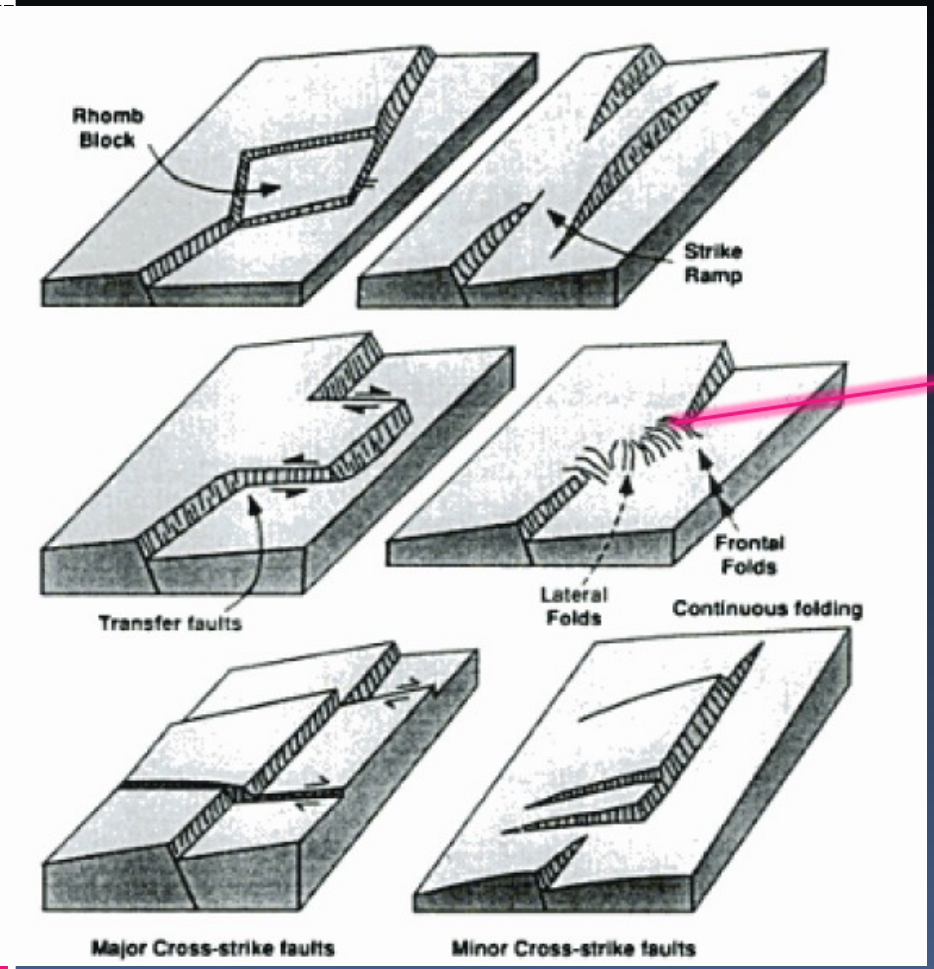


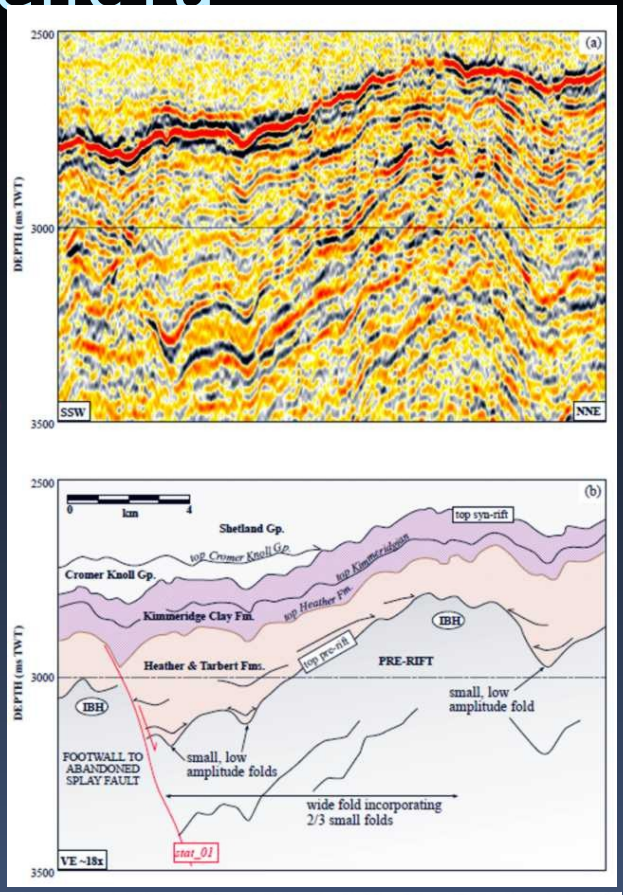
Falha normal planar na margem NW Grã-Bretanha. Maior deformação na capa.

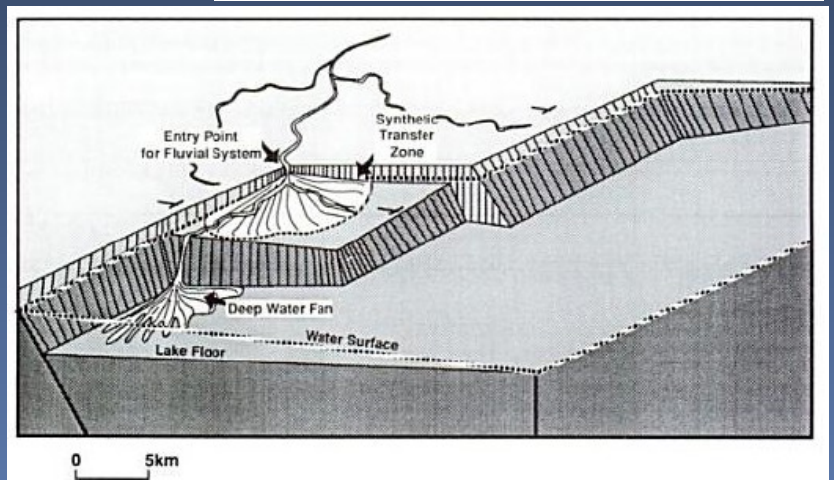
Interconexão entre falhas normais – zonas de acomodação ou de transferência



Tipos de zonas de transferência



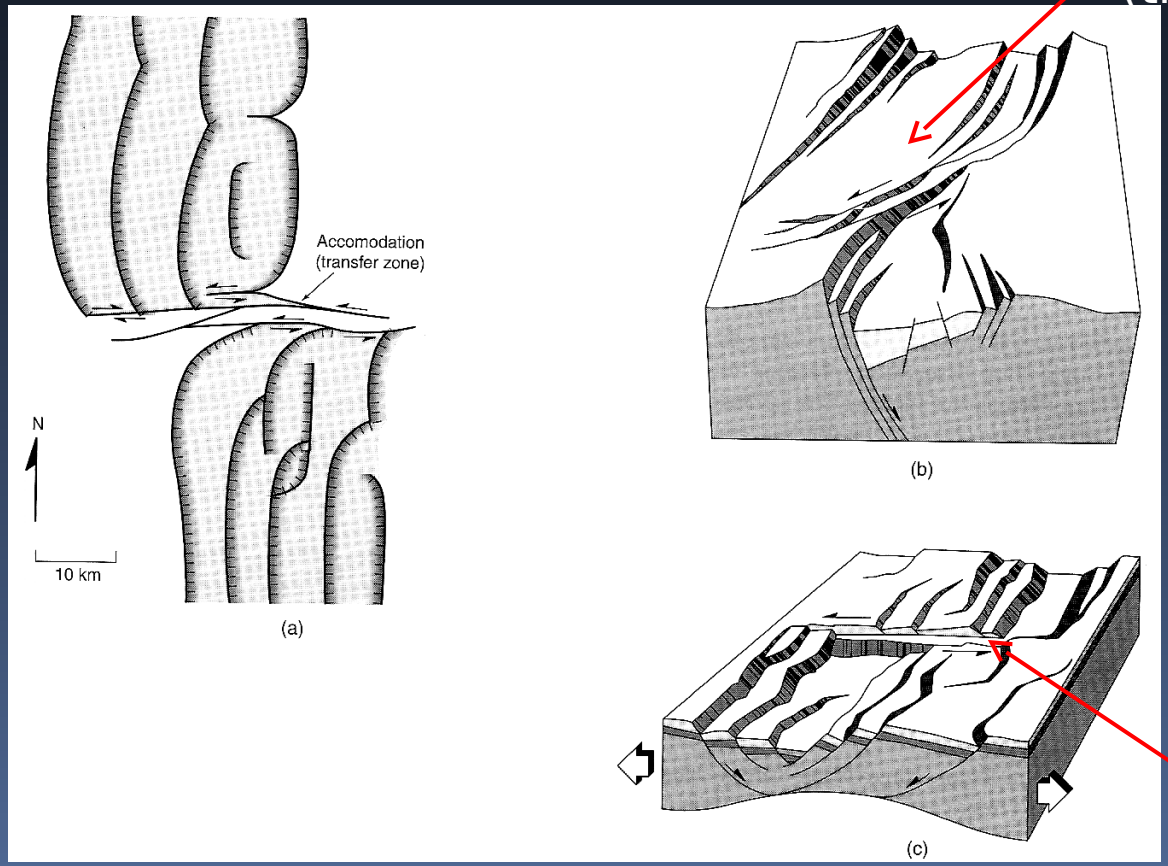


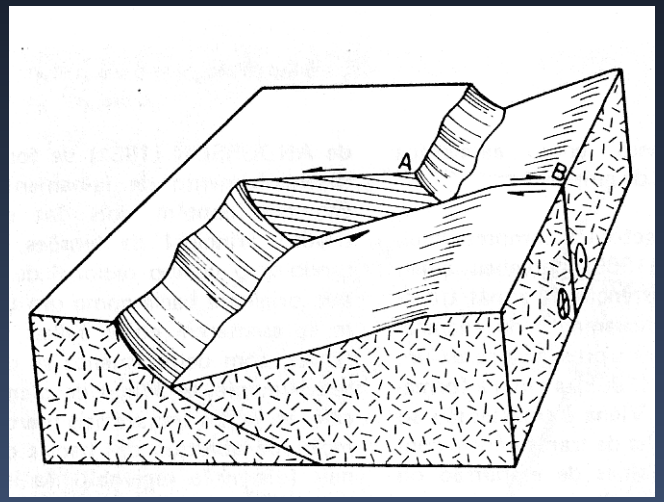


Zonas de transferência são captadoras de redes de drenagem → áreas-fonte principais em bacias rifte

Zonas de acomodação ou zonas de transferência

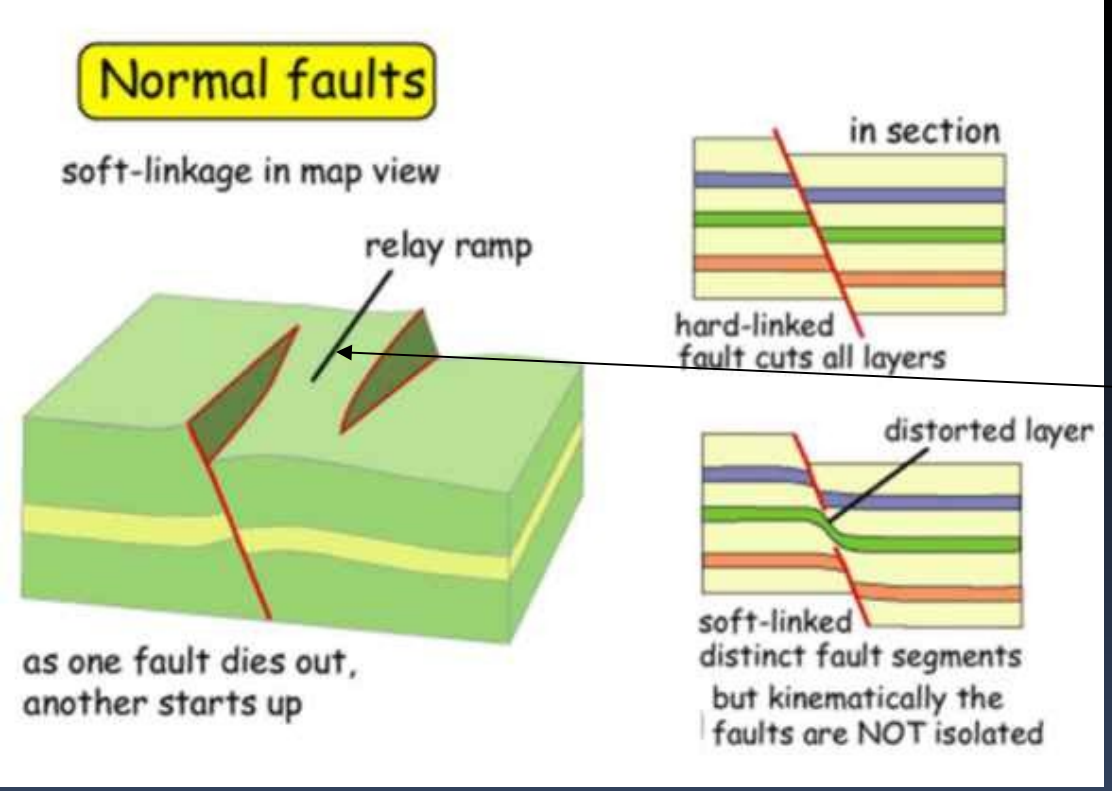
Rampa de revezamento (transferência *soft*)



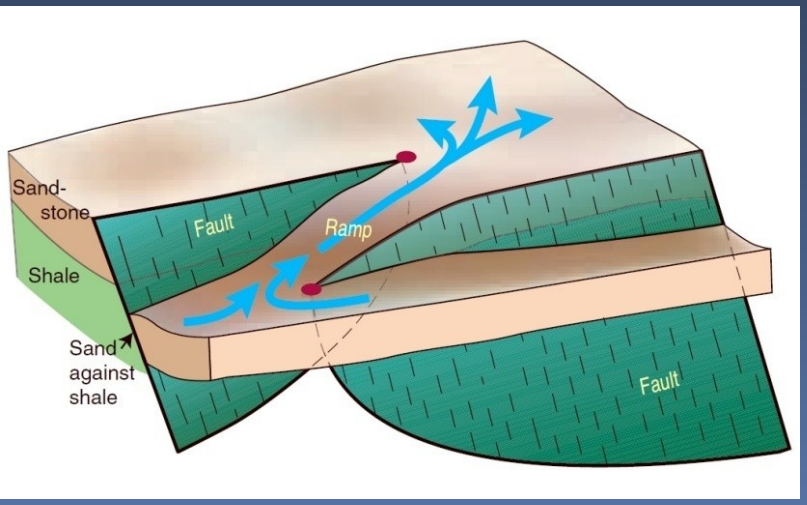


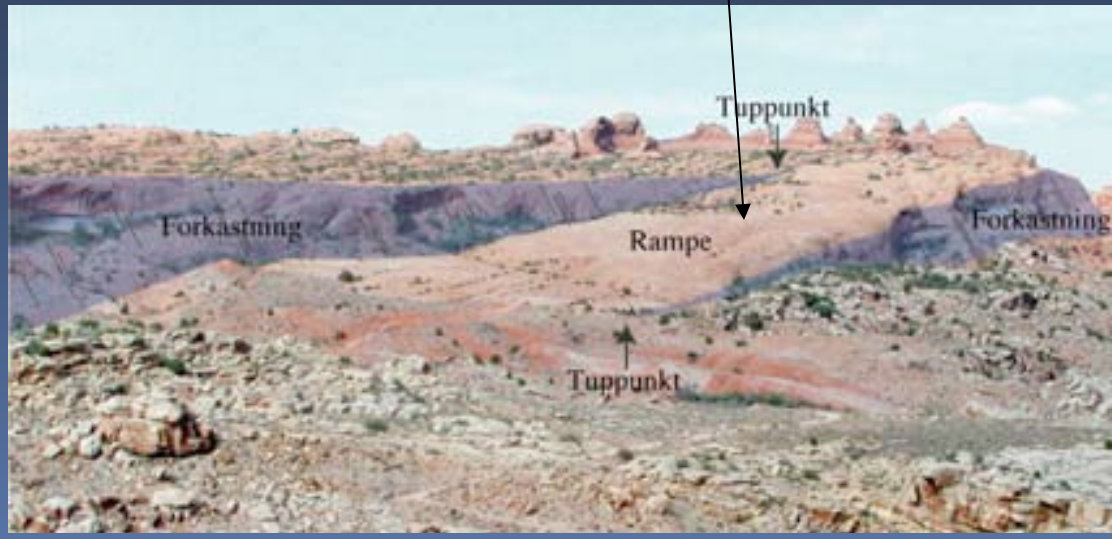
Milani (1989)

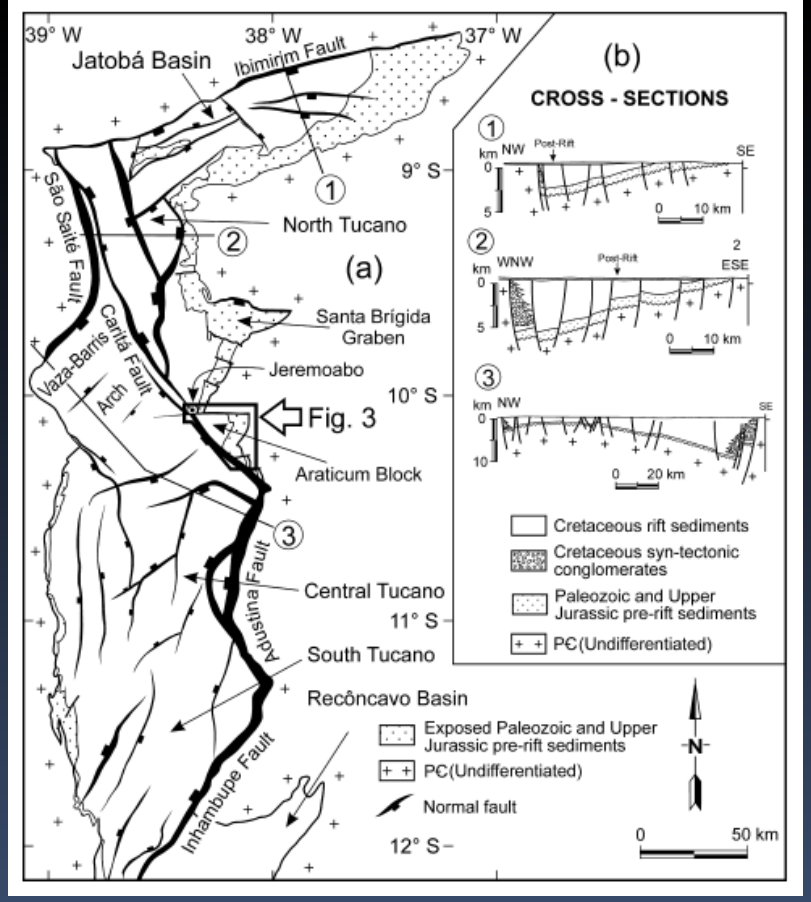
Falha de transferência (transferência *hard*)



Zonas de transferência do tipo rampas de revezamento

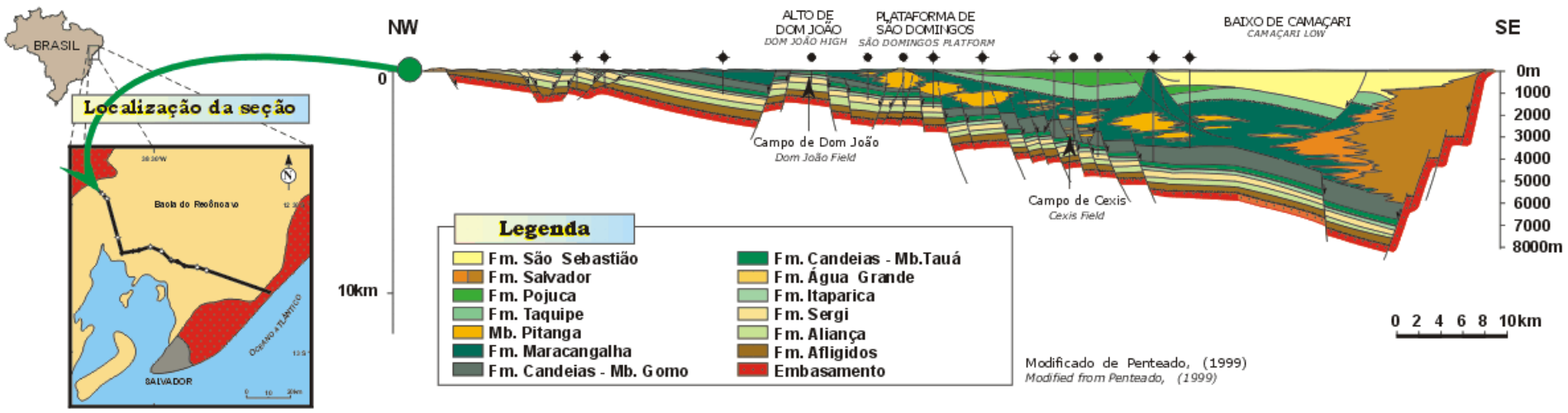


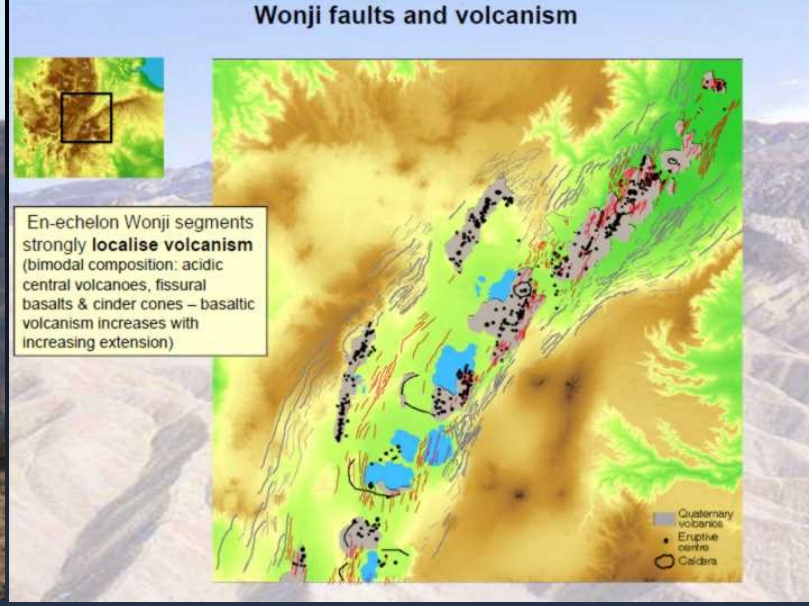




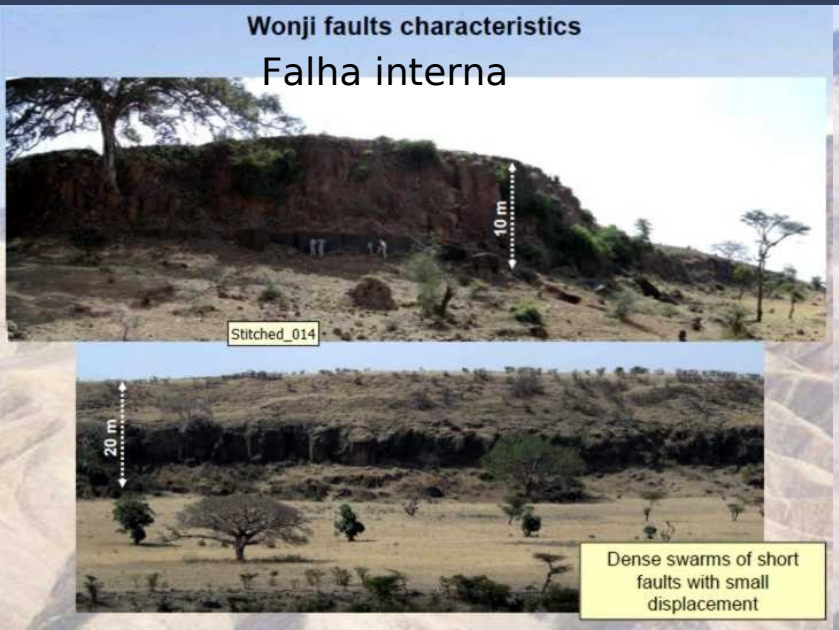
Falhas de transferência na bacia do Recôncavo (BA)

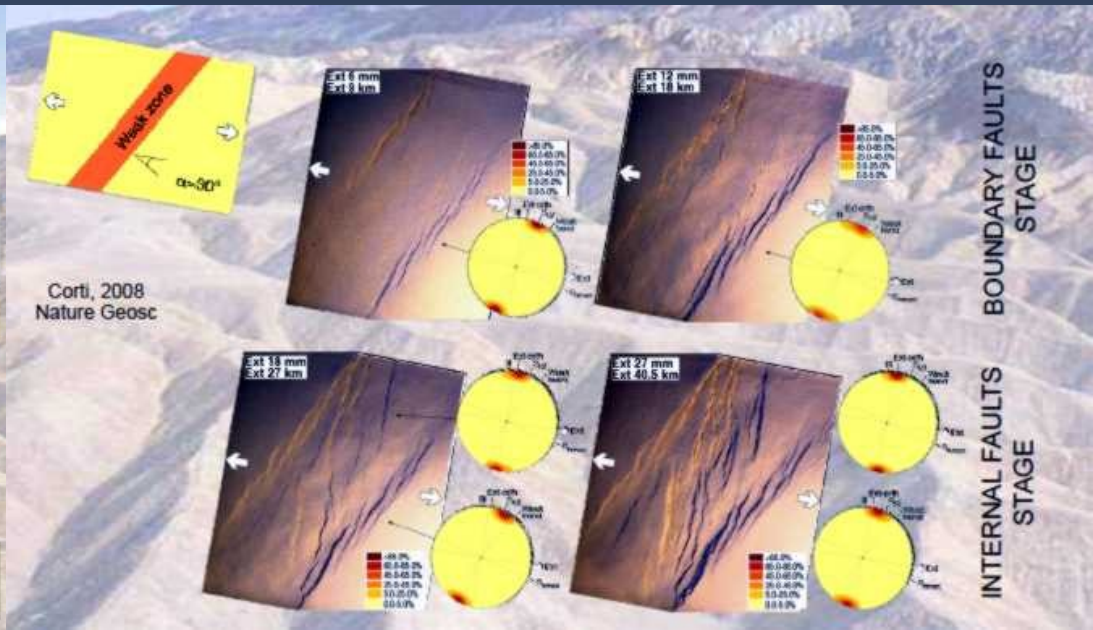
(Milani 1989 e Penteado 1999)

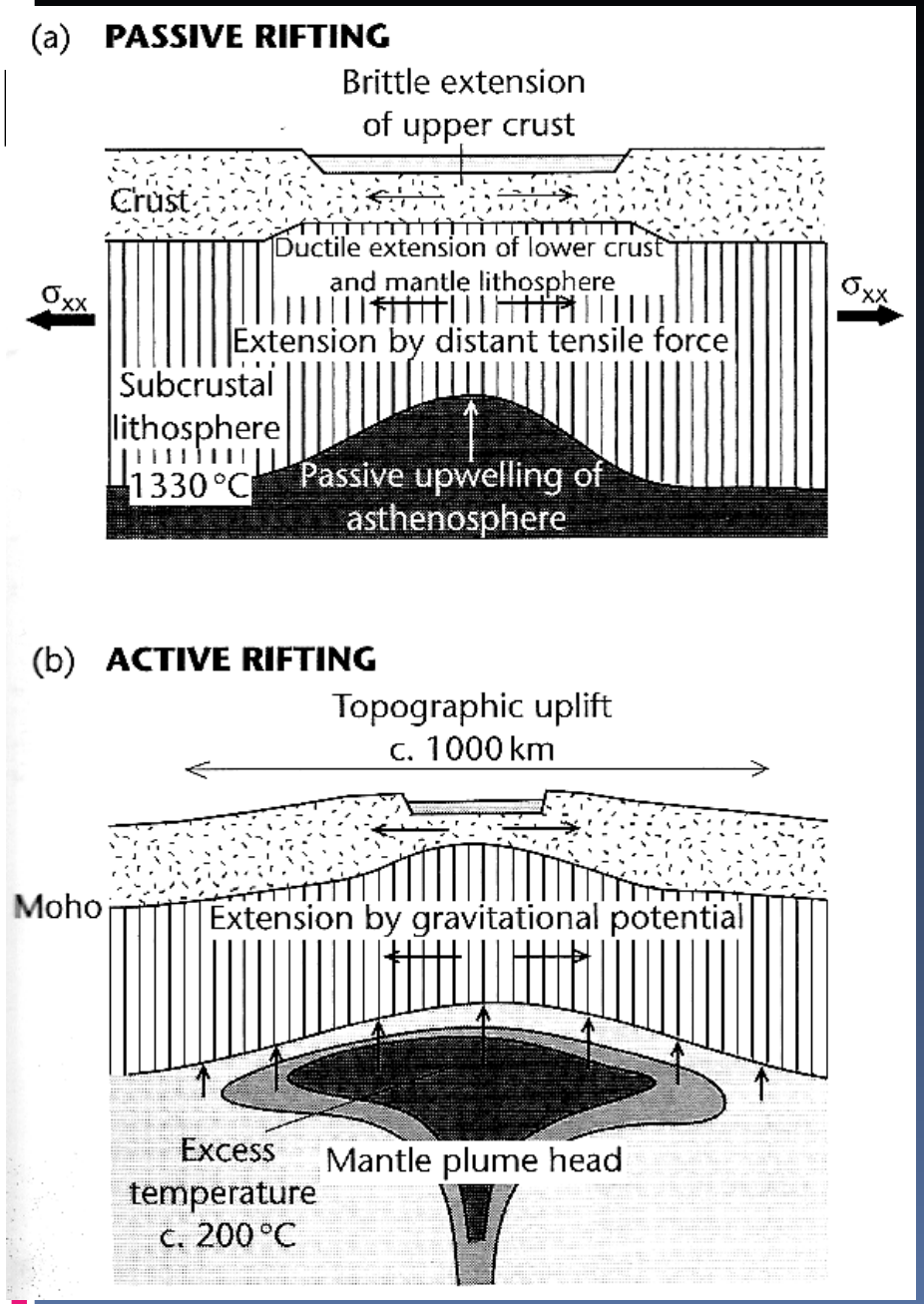




Rifte da Somália – falhas de borda e internas com orientação diferente → DISTENSÃO OBLÍQUA







PROCESSOS DE RIFTEAMENTO

PASSIVO

Relacionado com as tensões tectônicas regionais

ATIVO

Relacionado com anomalias térmicas sublitosféricas – plumas mantélicas (Δt entre 100 e 200 °C)